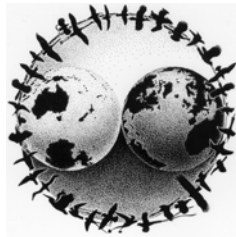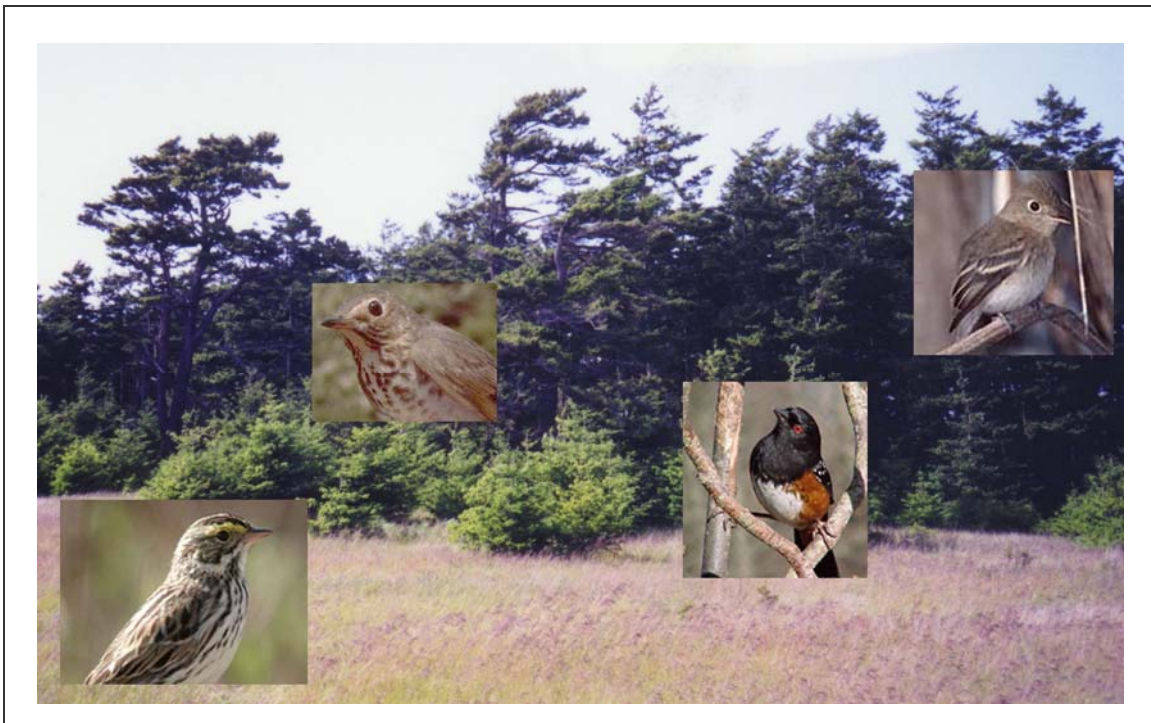# LANDBIRD INVENTORY OF
SAN JUAN ISLAND NATIONAL HISTORICAL PARK

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Introduction

The National Park Service (NPS) is charged with the responsibility of managing park natural resources and preventing their loss or impairment. To meet this responsibility, NPS established the Natural Resource Inventory and Monitoring Program (I&M) to provide funding and technical support to approximately 269 national park units. The goals of this program are to help park units collect scientifically credible ecological resource information and to develop or improve field and analytical monitoring techniques to aid park managers in managing, planning, and protecting their natural resources. As a first step toward meeting I&M goals, NPS initiated its Natural Resource Inventories Program in 2001. This five-year program emphasizes gathering a core set of data describing park vascular plant and vertebrate resources. Furthermore, parks within the North Coast / Cascades Network, including San Juan Island National Historical Park (NHP) held "vital signs" workshops to identify and implement a core program of monitoring. The network monitoring program focuses on the most critical ecological parameters and stressors identified for the network as a whole. All seven parks in the North Coast / Cascades Network identified landbirds as a critical faunal resource to be monitored.

The Olympic Mountains rainshadow, combined with maritime effects, produces climatic conditions at San Juan Island NHP that are unusual for western Washington. As a result, some of the park's plant communities, including the extensive prairie at American Camp and woodlands at British Camp that include Garry Oak and Rocky Mountain Juniper, are quite uncommon in Western Washington (Atkinson and Sharpe 1985). These unusual habitats, the overall pace of development in the San Juan Islands, and the archipelago's location within the Pacific flyway make the park more important for resident and migratory landbirds than it's relatively small size (roughly 700 ha) might suggest.

Birds are the most visible faunal component of the San Juan Island NHP ecosystem. Their high body temperature, rapid metabolism, and high ecological position in most food webs make them good indicators of the effects of local and regional changes in ecosystems (Furness et al. 1993). Their abundance and diversity in virtually all terrestrial habitats and their diurnal nature facilitate the monitoring of their populations. Birds also have tremendous public interest and support.

Reported declines of many birds breeding in North America have stimulated interest in avian population trends and mechanisms driving those trends (DeSante and George 1994). The North American Breeding Bird Survey suggests that landbird populations in Pacific Northwest late-seral forests appear to be in serious decline (Sauer et al. 2001). Although the avifauna of the San Juan Islands has been well described qualitatively (Lewis and Sharpe 1987, Smith et al. 1997), quantitative survey data for the islands, or the park, are lacking. Existing presence/absence data pertain more generally to San Juan Island than to the park, and in any case are insufficient for tracking population changes over time, or for gauging the effects of any future management

actions that may alter habitat conditions. These goals require species-specific density estimates.

The objective of this inventory is therefore to determine habitat-specific density of landbirds during the breeding season at San Juan Island NHP, using methods consistent with those employed in other parks across the North Coast / Cascades Network (Siegel and Kuntz II 2000, Siegel et al. 2002). These results may serve as baseline data for monitoring future ecological changes within the park.

METHODS

Survey design

We used existing geographic information systems (GIS) data to randomly select a starting point, and then overlaid a grid of survey points, 250 m apart, across both American Camp and English Camp. American Camp was large enough to accommodate 77 regularly-spaced survey points, while the smaller English Camp accommodated just 36 points. Point count coordinates for American Camp are provided in Table 1; point count coordinates for English Camp are provided in Table 2.

Although we designed this project strictly to inventory landbirds, we amassed numerous seabird and shorebird detections during the field season. Although we tabulate and analyze such detections in this report, we do not claim to have systematically surveyed for these species. These observations should be considered anecdotal, rather than systematically produced.

Data collection

We used five-minute variable circular-plot (VCP) point counts (Fancy and Sauer 2000, Siegel 2000) coupled with detailed habitat descriptions of each point count location as our primary means of surveying birds. VCP point counts entailed recording the horizontal distance, estimated to the nearest meter, to every bird seen or heard during the point count.

Heidi Pedersen conducted all point counts in numerical order at each camp, between May 23 and June 19. Heidi generally worked one day at English Camp after every two consecutive days at American Camp, so that surveys at both camps would be spread across the same general time period. Each morning in the field, she conducted approximately 9 point counts. She conducted all counts at pre-selected point count locations, which were located in the field with topographic maps and a hand-held GPS unit. Survey points were temporarily flagged, to facilitate collecting habitat data at the point later in the day.

Point counts began within ten minutes of local sunrise, and continued until no later than 3.5 hours after local sunrise. 'Flyovers'— defined as birds that flew over the top of the vegetation canopy, never touched down in the observer's field of view, and did not appear to be foraging, displaying, or behaving in any other way that might suggest a

link to the habitat below— were tallied separately from other bird detections. Individual birds thought to have been recorded previously at another point were marked accordingly on the data forms.

Vegetation descriptions entailed collecting data on vegetation structure and composition within a 50 m radius circular plot centered on each survey point, and then assigning a primary habitat classification to the plot (Table 3). Vegetation plots occasionally straddled more than one distinct habitat type; in these cases observers classified the point as being dominated by the habitat that covered the larger portion of the plot, and then additionally recorded the 'secondary' habitat present in the plot. We utilized the same habitat classification system we are using at other parks in the North Coast / Cascades Network (Siegel et al. 2002), to facilitate inter-park comparisons of results for shared habitats.

We also recorded cover, average height, and species composition of four vegetation layers (ground-cover, understory, sub-canopy and canopy), determined density of dominant plant species, measured the canopy cover using a spherical densiometer, and recorded summary plot characteristics such as aspect, slope, and the presence of running or standing water. Although not utilized in the present analysis, the resulting database is being submitted with this report.

Additionally, whenever Heidi detected species thought to be rare in the park, she completed a "Rare Bird Report Form", including descriptions of the birds' appearance, behavior and geographic coordinates. These reports covered not only birds detected during point counts, but also birds detected while sampling vegetation, relaxing on days off, or at any other time during the field season.

Training and testing

At the beginning of the field season, Heidi, who was already a fairly skilled birder, underwent an intensive two-week training program along with our crews at North Cascades and Olympic National Parks. All crew members received training in visual and aural bird identification, distance estimation, plant identification, orienteering, backcountry safety, and project protocols. Bird identification skills were honed by spending days in the field birding and practicing point counts with experienced trainers, and then reviewing at night with the aid of field guides, taped songs and calls, and an instructional CD-ROM. At the end of the training period, Heidi passed a rigorous exam involving the identification of approximately 100 taped songs and calls (some of them grouped together in rapid succession to produce 'simulated point counts') as well as 20-30 photographic images.

Data entry and verification

All data were entered into DBASE databases, which were then checked for errors using an array of automated and manual data verification routines. Copies of these databases accompany this report.

Data analysis

Within each habitat, each species' apparent density, uncorrected for detectability, was calculated as

$$\frac{(d_{50}/p_{hab})}{0.7854} ,$$

where d_{50} is the total number of 50 m radius detections tallied at all points in that habitat, p_{hab} is the total number of points sampled within that habitat type, and 0.7854 is the portion of a hectare covered by a 50 m radius circle.

The effective detection radius for birds during point counts has been shown to vary across habitats and between species (Burnham 1981, Barker and Sauer 1995). Where sample sizes allow, it is therefore necessary to correct for habitat- and species-specific variability in detectability, before densities of different species can be compared with one another, across habitats, or with values from other studies (Buckland et al. 2001).

For frequently detected species in adequately well-represented habitats, we used the computer program Distance 4.0 (Thomas et al. 2002) to estimate absolute density. Buckland et al. (2001) advise that at least 60-80 detections are necessary for reliably modeling the relationship between detection probability and distance from the observer, but more recently other scientists have suggested that this threshold may be overly conservative. We classified each of the park habitats as belonging to one of two habitat groups— 'forested' or 'open' (Table 3)— and then pooled data within each of these habitat groups to fit species-specific detection functions for each species detected at least 40 times within a habitat group.

Even using our more liberal threshold of 40 detections, we amassed an adequate number of detections to model detection probability in at least one habitat group for just nine species. To fit detection functions for each of these nine species in each habitat group with at least 40 detections, we discarded the highest 5% of detection distances (Buckland et al. 2001), and then used the half-normal key function with the cosine series expansion, a combination which we found best fit the data for nearly every species in every habitat we investigated as part of a similar project at North Cascades National Park Service Complex (Siegel et al. 2002). We used the Akaike Information Criterion (AIC) to select among competing models (Akaike 1973, Burnham and Anderson 1998). We then applied the habitat group detection function separately to the data in each of the constituent habitats, to produce habitat-specific estimates of absolute abundance.

All Universal Transverse Mercator (UTM) coordinates and maps presented in this report are based on NAD83, Zone 10.

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RESULTS

Bird species detected in the park

All bird species detected during the 2002 field season, including 70 species detected during point counts and 18 additional species detected only at times other than during point counts, are listed in Table 4. During the course of our fieldwork, we also opportunistically discovered nests of numerous species. These nests, along with their UTM coordinates, are presented in Table 5.

General survey results

We recorded 1,728 individual bird detections during 113 point counts throughout the park—77 at American Camp and 36 at English Camp. Four habitats— Douglas-fir, Mixed Conifer, Shrub, and Grassland— were relatively well represented, while the other habitats included no more than five points each (Table 6; Figure 1 and Figure 2). Results, particularly species lists, for the poorly sampled habitats should merely be considered anecdotal.

Among the well-sampled habitats, the average number of birds detected per point was quite similar for the three 'forested' habitats, but much lower for the structurally less complex Grassland points (Table 6). The total number of species detected within a 50 m radius of survey points showed minimal variation among all four well-sampled habitats (Table 6), but when detections at any distance were included, the shrub and grassland points logged more species than the forest points (Table 6). Many of the 'additional' species were distant shorebirds that could not be seen from the forest points.

Detailed point count results for each habitat are presented in Tables 7-15. For each habitat we list all species that were detected during point counts, including flyovers. Apparent densities of all species detected during point counts in each habitat are presented together in Table 16.

Maps indicating the survey points at which each species was detected are provided in Figures 3 – 62. Readers should keep in mind that lack of detection at a given point merely means that the species was not detected during the five-minute sampling period there. It does not conclusively mean the species was absent.

Distance analysis

The six species for which we amassed at least 40 detections in forested habitats and the three species for which we amassed at least 40 detections in open habitats are listed in tables 17 and 18, respectively. The tables provide species-specific density for each constituent habitat, along with coefficients of variation, degrees of freedom, and 95% confidence intervals.

DISCUSSION

Limitations of our dataset

The small land mass comprised by San Juan Island NHP limited the number of points we could survey, and consequently, our sample sizes. We were able to correct for detectability and produce estimates of absolute (rather than relative) abundance for just nine species, and sample sizes for several of these were less than optimal. Perhaps as a result of this, the correspondence between uncorrected 'apparent' density estimates and corrected density estimates was very poor (Tables 17 and 18). Indeed, the uncorrected estimates for some species in some habitats were outside the 95% confidence intervals of the corrected estimates. These discrepancies underscore the pitfalls of relying on uncorrected density estimates, and illustrate the need for distance sampling. Nevertheless, we were surprised by the magnitude of the discrepancies, as they were much greater than those we calculated from similar (albeit larger) data sets at North Cascades NP (Siegel et al. 2002).

The raw point count data accompany this report. If it becomes desirable to resurvey the park again in the future, the data analyst may wish to pool our results with future results when fitting detection functions, thereby increasing the sample sizes.

Species of particular interest

While our survey was designed more to produce quantitative density estimates for common species than to uncover rare species, a few of the birds we detected this season are worth highlighting.

Common Loon. Lewis and Sharpe (1987) describe this species as 'rare to very uncommon' during June, when we detected it in Griffin Bay.

Hutton's Vireo. Lewis and Sharpe (1987) describe Hutton's Vireo as an 'uncommon breeding resident' on the San Juan Islands, and while detections were certainly sparse, we recorded them singing during a single point count at both American Camp and British Camp.

Varied Thrush. Although considered 'uncommon to fairly common' on the San Juan Islands in general (Lewis and Sharpe 1987), this species is most commonly found in heavily forested habitats well above sea level during the breeding season. Our single detection of a Varied Thrush singing at American Camp in early June is therefore notable.

MacGillivray's Warbler. Considered 'locally troubled' and 'a rare breeder' by Lewis and Sharpe (1987) this species is believed to have declined sharply on the San Juan Islands during the past several decades, possibly due to cowbird parasitism. We observed a female carrying nesting material near the southern edge of English Camp (where MacGillivray's Warblers were also detected

singing during two point counts) indicating that nesting may still occur within the park boundary.

Other species were notable because of their absence or rarity.

Eurasian Skylark. First seen on San Juan Island in 1960, this introduced species was considered a 'locally common breeding resident' in the grasslands at American Camp by Lewis and Sharpe (1987). In recent years the population has declined, however, and the last confirmed breeding season sighting we are aware of was in 1999 (Barb Jenson, pers. comm.). We detected no skylarks during our field season. Given the amount of time we spent at American Camp, and the conspicuousness of skylark song, we are nearly certain that no skylarks bred at American Camp this year. This species' ground-nesting habits may make it particularly vulnerable to predation by feral cats.

Vesper Sparrow. We detected Vesper Sparrows at just four points at American Camp, despite Lewis and Sharpe's (1987) classification of them as 'common to abundant' in grassland habitat on the islands. The American Camp population has evidently declined in recent years (Mark Lewis, pers. comm.). Again, because this species nests on the ground, feral cats must be considered a possible cause of the decline.

Conservation issues

Feral cats may represent one of the more serious conservation issues facing the avifauna of San Juan Island NHP. Cats are particularly conspicuous at American Camp, where they may be playing a role in the local decline of Eurasian Skylark and Vesper Sparrow. Fortunately, this is also a problem that *can* be addressed, without an inordinately high investment of resources. Feral cat removal at American Camp is almost surely the single most effective conservation measure park managers could take to benefit the park's avifauna. Introduced Red Fox, also conspicuous at American Camp, may also contribute to declines of ground-nesting birds.

Much more difficult to address are the problems associated with high densities of European Starlings and Brown-headed Cowbirds, both among the most frequently detected bird species in the park. European Starlings are known to displace other bird species from their nest cavities, and Brown-headed Cowbirds are obligate nest parasites. Cowbirds have been implicated in the local decline of MacGillivray's Warbler (Lewis and Sharpe 1987), and may affect the population dynamics of other species as well.

ACKNOWLEDGEMENTS

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Table 1. Point count locations and field-based habitat classifications at American Camp.
Northings and eastings are Zone 10 UTM coordinates based on NAD83.

Point	Northing	Easting	Primary Habitat	Secondary Habitat
A001	5367444	498096	Grassland	
A002	5367694	498096	Grassland	
A003	5367944	489096	Shrub	
A004	5368194	489096	Mixed Conifer	
A005	5368444	498096	Mixed Conifer	
A006	5368440	497846	Shrub	
A007	5368194	497846	Shrub	
A008	5367194	498346	Grassland	
A009	5367444	498346	Shrub	Grassland
A010	5367694	498346	Shrub	Grassland
A011	5367944	498346	Grassland	Douglas-fir
A012	5368194	498346	Mixed Conifer	Shrub
A013	5368444	498346	Mixed Conifer	
A014	5368444	498596	Mixed Conifer	Shrub
A015	5368194	498596	Shrub	
A016	5367944	498596	Grassland	
A017	5367694	498596	Grassland	
A018	5367444	498596	Grassland	Shrub
A019	5367194	498596	Grassland	
A020	5367194	498846	Grassland	
A021	5367444	498846	Grassland	
A022	5367694	498846	Grassland	
A023	5367944	498846	Grassland	
A024	5368194	498846	Grassland	
A025	5368444	498846	Conifer Deciduous Mix	Red Alder
A026	5368444	499096	Mixed Conifer	
A027	5368194	499096	Red Alder	
A028	5367944	499096	Grassland	Shrub
A029	5367694	499096	Grassland	
A030	5367444	499096	Grassland	Shrub
A031	5367194	499096	Grassland	
A032	5367194	499346	Grassland	
A033	5367444	499346	Grassland	
A034	5367694	499346	Grassland	
A035	5367944	499346	Shrub	
A036	5368194	499346	Red Alder	
A037	5368433	499346	Shrub	Red Alder
A038	5368444	499596	Shrub	
A039	5368194	499596	Red Alder	
A040	5367944	499596	Grassland	Shrub
A041	5367694	499596	Grassland	
A042	5367444	499596	Grassland	
A043	5367220	499596	Shrub	
A044	5367194	499846	Grassland	Shrub
A045	5367444	499846	Grassland	
A046	5367694	500096	Grassland	
A047	5367944	499858	Shrub	
A048	5368194	499846	Shrub	
A049	5367944	500096	Shrub	
A050	5367694	499846	Grassland	

Table 1, cont.

Point	Northing	Easting	Primary Habitat	Secondary Habitat
A051	5367444	500096	Sand Dune	Grassland
A052	5367194	500096	Sand Dune	
A053	5366944	500096	Beach	
A054	5366944	500346	Grassland	Beach
A055	5367194	500346	Grassland	
A056	5367444	500346	Grassland	
A057	5367694	500346	Douglas-fir	
A058	5367694	500596	Mixed Conifer	Douglas-fir
A059	5367460	500624	Mixed Conifer	
A060	5367194	500596	Grassland	
A061	5366944	500596	Grassland	
A062	5366944	500846	Grassland	
A063	5367194	500846	Grassland	Mixed Conifer
A064	5367410	500846	Mixed Conifer	Beach
A065	5367444	501096	Mixed Conifer	
A066	5367194	501096	Grassland	
A067	5366944	501096	Grassland	
A068	5366944	501346	Grassland	
A069	5367194	501346	Grassland	
A070	5367444	501346	Mixed Conifer	
A071	5367694	501346	Douglas-fir	Mixed Conifer
A072	5367444	501596	Mixed Conifer	
A073	5367194	501596	Mixed Conifer	Conifer Deciduous Mix
A074	5366944	501596	Grassland	
A075	5366944	501846	Grassland	
A076	5367194	501846	Mixed Conifer	
A077	5367444	501846	Mixed Conifer	

Table 2. Point count locations and field-based habitat classifications at English Camp.
Northings and eastings are Zone 10 UTM coordinates based on NAD83.

Point	Northing	Easting	Primary Habitat	Secondary Habitat
B001	5380789	489139	Shrub	Red Alder
B002	5380789	489389	Shrub	
B003	5380789	489639	Shrub	
B004	5380789	489889	Douglas-fir	Grassland
B005	5381039	489889	Douglas-fir	
B006	5381039	489639	Grassland	
B007	5381039	489389	Grassland	Grassland
B008	5381039	489139	Douglas-fir	
B009	5381289	489139	Douglas-fir	
B010	5381289	489389	Douglas-fir	
B011	5381289	489639	Douglas-fir	Conifer Deciduous Mix
B012	5381289	489889	Douglas-fir	
B013	5381539	489889	Mixed Conifer	Douglas-fir
B014	5381539	489639	Conifer Deciduous Mix	Mixed Conifer
B015	5381539	489389	Douglas-fir	Mixed Conifer
B016	5381539	489139	Red Alder	
B017	5381539	488889	Developed Area	
B018	5381789	488639	Douglas-fir	
B019	5381789	488889	Douglas-fir	
B020	5381789	489139	Douglas-fir	Conifer Deciduous Mix
B021	5381789	489389	Douglas-fir	
B022	5381789	489639	Douglas-fir	
B023	5381719	489889	Shrub	Douglas-fir
B024	5382039	489889	Douglas-fir	Shrub
B025	5382039	489639	Conifer Deciduous Mix	Douglas-fir
B026	5382039	489389	Conifer Deciduous Mix	Douglas-fir
B027	5382039	489139	Red Alder	
B028	5382039	488889	Douglas-fir	
B029	5382039	488639	Douglas-fir	
B030	5382289	489389	Douglas-fir	
B031	5382289	489639	Conifer Deciduous Mix	Douglas-fir
B032	5382289	489889	Shrub	
B033	5381539	490139	Douglas-fir	
B034	5381289	490139	Shrub	
B035	5381039	490139	Mixed Conifer	
B036	5380789	490139	Mixed Conifer	Conifer Deciduous Mix

Table 3. Habitat categories used for field-based classification of point count sites.

Habitat	Notes
'Forested' Habitats	
Douglas-fir	Coniferous forest with canopy $\geq$ 80% Douglas-fir
Mixed Conifer	Coniferous forest with canopy <80% Douglas-fir
Conifer Deciduous Mix	Forest with canopy >20% conifer and >20% deciduous
Red Alder	Forest with canopy $\geq$80% Red Alder
Shrub	Overstory canopy cover <20%; shrub cover $\geq$50%
'Open' Habitats	
Grassland	Overstory canopy cover <20%; shrub cover < 50%
Sand Dune	
Beach	
Developed Area	Manicured lawn or other landscaped areas near buildings

Table 4. All species detected in the park during our 2002 field season. Asterisks indicate species that were never detected during point counts.

1. Pacific Loon	45. Tree Swallow
2. Common Loon*	46. Violet-green Swallow
3. Double-crested Cormorant	47. Northern Rough-winged Swallow
4. Pelagic Cormorant*	48. Cliff Swallow
5. Turkey Vulture*	49. Barn Swallow
6. Canada Goose	50. Chestnut-backed Chickadee
7. Mallard*	51. Bushtit
8. Gadwall*	52. Red-breasted Nuthatch
9. Surf Scoter	53. Brown Creeper
10. White-winged Scoter	54. Bewick's Wren
11. Red-breasted Merganser	55. House Wren
12. Osprey	56. Winter Wren
13. Golden Eagle*	57. Marsh Wren
14. Bald Eagle	58. Golden-crowned Kinglet
15. Northern Harrier	59. Varied Thrush*
16. Cooper's Hawk*	60. American Robin
17. Red-tailed Hawk	61. Swainson's Thrush
18. Killdeer*	62. European Starling
19. Spotted Sandpiper*	63. Cedar Waxwing
20. Wild Turkey	64. Orange-crowned Warbler
21. California Quail	65. Yellow Warbler
22. Black Oystercatcher	66. Yellow-rumped Warbler (Audubon's race)
23. Glaucous-winged Gull	67. Black-throated Gray Warbler
24. Pigeon Guillemot*	68. Townsend's Warbler
25. Rhinoceros Auklet*	69. MacGillivray's Warbler
26. Band-tailed Pigeon	70. Common Yellowthroat
27. Great Horned Owl*	71. Wilson's Warbler
28. Barred Owl*	72. Western Tanager
29. Common Nighthawk*	73. Spotted Towhee
30. Rufous Hummingbird	74. Chipping Sparrow
31. Belted Kingfisher*	75. Vesper Sparrow
32. Downy Woodpecker*	76. Savannah Sparrow
33. Hairy Woodpecker	77. Song Sparrow
34. Northern Flicker	78. White-crowned Sparrow
35. Pileated Woodpecker	79. Dark-eyed Junco
36. Olive-sided Flycatcher	80. Black-headed Grosbeak
37. Willow Flycatcher	81. Red-winged Blackbird
38. Pacific-slope Flycatcher	82. Brewer's Blackbird
39. Cassin's Vireo	83. Brown-headed Cowbird
40. Hutton's Vireo	84. Purple Finch
41. Warbling Vireo	85. House Finch
42. American Crow	86. Red Crossbill
43. Common Raven	87. Pine Siskin
44. Purple Martin*	88. American Goldfinch

Table 5. Active nests discovered opportunistically during the field season.

Species	Date Found	Northing	Easting	Notes
American Camp				
Bald Eagle	05/29/02	5367909	498171	Just south of American Camp visitor center.
Pileated Woodpecker	06/03/02	5367460	501580	Located 13m above ground near top of Red Alder snag.
Winter Wren	06/03/02	5367440	501600	Nest in a cavity 8 m high in a 10 cm dbh Douglas-fir snag.
English Camp				
Osprey	05/31/02	5381724	489120	Nest at top of 50 m tall Douglas-fir.
Downy Woodpecker	06/18/02	5381510	489190	Excavated in Red Alder snag at east end of visitor parking lot.
Hairy Woodpecker	06/06/02	5381986	489694	Cavity near top of 9 m tall, 18 cm dbh Douglas-fir snag.
Cassin's Vireo	06/07/02	5382265	489866	Nest built 3 m above ground in a Madrone.
Red-breasted Nuthatch	05/31/02	5381790	489718	Cavity 12 m above ground in a Douglas-fir snag.
Orange-crowned Warbler	06/07/02	5381793	488655	No cowbird eggs.
MacGillivray's Warbler	05/23/02	5380797	489649	Female observed w/ nesting material near south edge of park.
Spotted Towhee	06/01/02	5381017	489382	Built on ground under grass, shrubs, saplings. No cowbird eggs.
White-crowned Sparrow	06/01/02	5381184	489872	Built on ground under sparse Manzanita. No cowbird chicks.
Dark-eyed Junco	06/01/02	5381289	489389	No cowbird eggs.
Dark-eyed Junco	06/06/02	5382174	488579	No cowbird eggs.

Table 6. Summary point count results by habitat.

Habitat	No. points surveyed	Avg. no. of birds detected ($\leq$50 m)	Total no.of species detected ($\leq$50 m)	Total no. of species detected (unlim. radius)
Douglas-fir	20	9.95	28	38
Mixed Conifer	18	10.65	33	42
Conifer Deciduous Mix	5	8.71	17	23
Red Alder	5	8.69	15	23
Shrub	19	10.49	35	50
Grassland	42	4.40	29	47
Sand Dune	2	4.46	5	9
Beach	1	1.27	1	2
Developed Area	1	16.56	4	13
All Habitats Pooled	113	6.19	55	69

Table 7. Summary results from 20 point counts in Douglas-fir habitat. All species detected during Douglas-fir point counts are listed, including species detected only as flyovers. 'No. of Points with Detections' excludes flyovers; values of zero indicate species that were detected only as flyovers. 'No. Points with 50-m Radius Detections' excludes flyovers and individuals estimated to be greater than 50 m from the observer. 'Individuals Detected per Hectare' is based on the average number of birds detected within a 50 m radius.

Species	No. Points with Detections	No. Points with 50-m Radius Detections	Individuals Detected per Hectare
Canada Goose	6	0	0.00
Osprey	1	0	0.00
Bald Eagle	3	0	0.00
Wild Turkey	1	0	0.00
Band-tailed Pigeon	2	1	0.06
Rufous Hummingbird	3	3	0.19
Hairy Woodpecker	1	1	0.06
Pileated Woodpecker	3	1	0.06
Olive-sided Flycatcher	6	0	0.00
Pacific-slope Flycatcher	20	17	1.27
Cassin's Vireo	5	5	0.32
Hutton's Vireo	1	0	0.00
Warbling Vireo	1	0	0.00
Common Raven	3	0	0.00
Chestnut-backed Chickadee	14	14	1.27
Red-breasted Nuthatch	12	5	0.45
Brown Creeper	4	0	0.00
House Wren	2	2	0.13
Winter Wren	1	0	0.00
Golden-crowned Kinglet	2	2	0.13
Swainson's Thrush	9	4	0.26
American Robin	16	8	0.70
Orange-crowned Warbler	13	7	0.45
Yellow-rumped Warbler	3	1	0.06
Black-throated Gray Warbler	3	2	0.13
Townsend's Warbler	5	4	0.26
Wilson's Warbler	1	1	0.06
Western Tanager	4	3	0.19
Spotted Towhee	13	12	1.27
Chipping Sparrow	4	4	0.32
Song Sparrow	5	3	0.19
White-crowned Sparrow	6	4	0.26
Dark-eyed Junco	6	5	0.45
Brown-headed Cowbird	7	5	0.38
Purple Finch	1	1	0.06
Red Crossbill	4	4	0.45

Table 7, cont.

Species	No. Points with Detections	No. Points with 50-m Radius Detections	Individuals Detected per Hectare
Pine Siskin	2	2	0.19
American Goldfinch	1	1	0.13
All Species Pooled			**9.75**

Table 8. Summary results from 18 point counts in Mixed Conifer habitat. All species detected during Mixed Conifer point counts are listed, including species detected only as flyovers. 'No. of Points with Detections' excludes flyovers; values of zero indicate species that were detected only as flyovers. 'No. Points with 50-m Radius Detections' excludes flyovers and individuals estimated to be greater than 50 m from the observer. 'Individuals Detected per Hectare' is based on the average number of birds detected within a 50 m radius.

Species	No. Points with Detections	No. Points with 50-m Radius Detections	Individuals Detected per Hectare
Canada Goose	1	0	0.00
Osprey	1	0	0.00
Bald Eagle	4	0	0.00
Red-tailed Hawk	1	1	0.07
California Quail	1	0	0.00
Black Oystercatcher	1	0	0.00
Glaucous-winged Gull	0	0	0.00
Band-tailed Pigeon	2	1	0.07
Rufous Hummingbird	3	3	0.21
Pileated Woodpecker	1	1	0.07
Olive-sided Flycatcher	5	1	0.07
Pacific-slope Flycatcher	13	13	0.99
Hutton's Vireo	1	1	0.07
American Crow	3	0	0.00
Common Raven	6	2	0.28
No. Rough-winged Swallow	1	1	0.07
Chestnut-backed Chickadee	6	6	0.50
Red-breasted Nuthatch	7	1	0.07
Brown Creeper	3	2	0.14
Bewick's Wren	3	3	0.21
House Wren	3	2	0.14
Winter Wren	10	6	0.42
Marsh Wren	1	0	0.00
Golden-crowned Kinglet	7	7	0.64
Swainson's Thrush	11	6	0.42
American Robin	14	9	1.13
Cedar Waxwing	1	1	0.14
Orange-crowned Warbler	8	5	0.35
Yellow-rumped Warbler	2	1	0.07
Black-throated Gray Warbler	2	2	0.14
Townsend's Warbler	1	1	0.07
Western Tanager	2	0	0.00
Spotted Towhee	11	11	1.06
Song Sparrow	6	4	0.35
White-crowned Sparrow	4	3	0.28
Dark-eyed Junco	4	3	0.21

Table 8, cont.

Species	No. Points with Detections	No. Points with 50-m Radius Detections	Individuals Detected per Hectare
Brown-headed Cowbird	8	8	0.64
Purple Finch	2	2	0.14
House Finch	3	2	0.14
Red Crossbill	4	4	0.57
Pine Siskin	5	5	0.78
American Goldfinch	3	2	0.14
All Species Pooled			**10.65**

Table 9. Summary results from 5 point counts in Conifer Deciduous Mix habitat. All species detected during Conifer Deciduous Mix point counts are listed, including species detected only as flyovers. 'No. of Points with Detections' excludes flyovers; values of zero indicate species that were detected only as flyovers. 'No. Points with 50-m Radius Detections' excludes flyovers and individuals estimated to be greater than 50 m from the observer. 'Individuals Detected per Hectare' is based on the average number of birds detected within a 50 m radius.

Species	No. Points with Detections	No. Points with 50-m Radius Detections	Individuals Detected per Hectare
Canada Goose	1	0	0.00
Band-tailed Pigeon	2	1	0.26
Rufous Hummingbird	1	1	0.26
Hairy Woodpecker	1	0	0.00
Pileated Woodpecker	1	0	0.00
Pacific-slope Flycatcher	5	4	1.02
Cassin's Vireo	1	1	0.26
Warbling Vireo	3	2	0.51
Northwester Crow	1	1	0.26
Chestnut-backed Chickadee	1	1	0.26
Brown Creeper	1	1	0.26
Bewick's Wren	1	1	0.26
Winter Wren	1	1	0.26
Golden-crowned Kinglet	2	2	0.51
Swainson's Thrush	5	4	1.78
American Robin	5	2	0.51
Orange-crowned Warbler	3	0	0.00
Yellow-rumped Warbler	1	1	0.26
Black-throated Gray Warbler	1	0	0.00
Western Tanager	1	0	0.00
Spotted Towhee	2	2	0.76
Song Sparrow	2	2	1.02
American Goldfinch	1	1	0.26
All Species Pooled			**8.71**

Table 10. Summary results from 5 point counts in Red Alder habitat. All species detected during Red Alder point counts are listed, including species detected only as flyovers. 'No. of Points with Detections' excludes flyovers; values of zero indicate species that were detected only as flyovers. 'No. Points with 50-m Radius Detections' excludes flyovers and individuals estimated to be greater than 50 m from the observer. 'Individuals Detected per Hectare' is based on the average number of birds detected within a 50 m radius.

Species	No. Points with Detections	No. Points with 50-m Radius Detections	Individuals Detected per Hectare
Canada Goose	1	0	0.00
Red-tailed Hawk	1	0	0.00
Band-tailed Pigeon	1	1	0.26
Rufous Hummingbird	1	1	0.26
Pileated Woodpecker	1	0	0.00
Pacific-slope Flycatcher	5	4	1.02
Warbling Vireo	1	1	0.26
American Crow	2	0	0.00
Red-breasted Nuthatch	1	0	0.00
Bewick's Wren	2	0	0.00
Winter Wren	3	0	0.00
Golden-crowned Kinglet	2	1	0.26
Swainson's Thrush	5	3	1.02
American Robin	4	3	1.78
Cedar Waxwing	2	1	0.76
Orange-crowned Warbler	1	1	0.26
Wilson's Warbler	1	1	0.26
Spotted Towhee	2	2	0.51
Song Sparrow	2	2	0.51
Dark-eyed Junco	1	0	0.00
Brown-headed Cowbird	2	2	0.76
Red Crossbill	1	1	0.26
American Goldfinch	1	1	0.51
All Species Pooled			**8.69**

Table 11. Summary results from 19 point counts in Shrub habitat. All species detected during Shrub point counts are listed, including species detected only as flyovers. 'No. of Points with Detections' excludes flyovers; values of zero indicate species that were detected only as flyovers. 'No. Points with 50-m Radius Detections' excludes flyovers and individuals estimated to be greater than 50 m from the observer. 'Individuals Detected per Hectare' is based on the average number of birds detected within a 50 m radius.

Species	No. Points with Detections	No. Points with 50-m Radius Detections	Individuals Detected per Hectare
Bald Eagle	1	0	0.00
Northern Harrier	1	0	0.00
Red-tailed Hawk	2	0	0.00
California Quail	1	1	0.13
Black Oystercatcher	1	0	0.00
Glaucous-winged Gull	1	0	0.00
Band-tailed Pigeon	1	0	0.00
Rufous Hummingbird	7	7	0.60
Hairy Woodpecker	2	0	0.00
Northern Flicker	4	1	0.07
Pileated Woodpecker	1	1	0.07
Olive-sided Flycatcher	3	0	0.00
Willow Flycatcher	1	0	0.00
Pacific-slope Flycatcher	8	5	0.34
Cassin's Vireo	2	2	0.13
American Crow	8	2	0.13
Common Raven	2	0	0.00
Barn Swallow	2	1	0.07
Chestnut-backed Chickadee	3	3	0.27
Red-breasted Nuthatch	4	1	0.07
Brown Creeper	1	1	0.07
Bewick's Wren	3	1	0.07
House Wren	2	2	0.13
Marsh Wren	4	3	0.20
Swainson's Thrush	11	11	0.74
American Robin	18	11	1.07
European Starling	1	0	0.00
Cedar Waxwing	2	1	0.27
Orange-crowned Warbler	12	4	0.27
Yellow Warbler	1	1	0.07
Yellow-rumped Warbler	3	2	0.13
Black-throated Gray Warbler	2	1	0.07
Townsend's Warbler	1	0	0.00
MacGillivray's Warbler	2	1	0.13
Common Yellowthroat	5	3	0.20
Wilson's Warbler	1	0	0.00

Table 11, cont.

Species	No. Points with Detections	No. Points with 50-m Radius Detections	Individuals Detected per Hectare
Western Tanager	2	2	0.13
Spotted Towhee	12	10	0.87
Chipping Sparrow	1	1	0.07
Savannah Sparrow	2	1	0.07
Song Sparrow	7	4	0.40
White-crowned Sparrow	9	4	0.40
Dark-eyed Junco	1	1	0.07
Black-headed Grosbeak	1	0	0.00
Red-winged Blackbird	3	2	1.07
Brown-headed Cowbird	9	7	0.94
House Finch	7	3	0.40
Red Crossbill	0	0	0.00
Pine Siskin	4	2	0.27
American Goldfinch	7	7	0.67
All Species Pooled			**10.66**

Table 12. Summary results from 42 point counts in Grassland habitat. All species
detected during Grassland point counts are listed, including species detected only as
flyovers. 'No. of Points with Detections' excludes flyovers; values of zero indicate
species that were detected only as flyovers. 'No. Points with 50-m Radius Detections'
excludes flyovers and individuals estimated to be greater than 50 m from the observer.
'Individuals Detected per Hectare' is based on the average number of birds detected
within a 50 m radius.

Species	No. Points with Detections	No. Points with 50-m Radius Detections	Individuals Detected per Hectare
Pacific Loon	2	0	0.00
Double-crested Cormorant	2	0	0.00
Canada Goose	3	0	0.00
Surf Scoter	1	0	0.00
White-winged Scoter	5	0	0.00
Red-breasted Merganser	1	0	0.00
Bald Eagle	13	0	0.00
Red-tailed Hawk	6	1	0.03
California Quail	2	0	0.00
Glaucous-winged Gull	11	3	0.15
Rufous Hummingbird	6	6	0.21
Northern Flicker	4	1	0.03
Olive-sided Flycatcher	6	0	0.00
Willow Flycatcher	2	0	0.00
Pacific-slope Flycatcher	2	1	0.03
American Crow	18	1	0.03
Common Raven	5	0	0.00
Tree Swallow	1	0	0.00
Violet-green Swallow	1	0	0.00
Cliff Swallow	1	1	0.03
Chestnut-backed Chickadee	2	1	0.03
Bushtit	1	0	0.00
Red-breasted Nuthatch	1	0	0.00
Bewick's Wren	8	2	0.09
House Wren	5	3	0.09
Winter Wren	2	1	0.03
Swainson's Thrush	4	1	0.03
American Robin	15	6	0.21
European Starling	6	1	0.03
Orange-crowned Warbler	7	3	0.12
Townsend's Warbler	1	0	0.00
Common Yellowthroat	3	0	0.00
Western Tanager	3	1	0.06
Spotted Towhee	14	3	0.09
Chipping Sparrow	2	2	0.09
Vesper Sparrow	3	1	0.03

Table 12, cont.

Species	No. Points with Detections	No. Points with 50-m Radius Detections	Individuals Detected per Hectare
Savannah Sparrow	33	27	1.39
Song Sparrow	3	1	0.06
White-crowned Sparrow	26	12	0.46
Dark-eyed Junco	1	1	0.03
Red-winged Blackbird	10	1	0.06
Brewer's Blackbird	3	1	0.03
Brown-headed Cowbird	8	2	0.09
House Finch	9	6	0.39
Red Crossbill	1	0	0.00
Pine Siskin	4	3	0.12
American Goldfinch	11	6	0.36
All species pooled			**4.40**

Table 13. Summary results from 2 point counts in Sand Dune habitat. All species detected during Sand Dune point counts are listed, including species detected only as flyovers. 'No. of Points with Detections' excludes flyovers; values of zero indicate species that were detected only as flyovers. 'No. Points with 50-m Radius Detections' excludes flyovers and individuals estimated to be greater than 50 m from the observer. 'Individuals Detected per Hectare' is based on the average number of birds detected within a 50 m radius.

Species	No. Points with Detections	No. Points with 50-m Radius Detections	Individuals Detected per Hectare
Bald Eagle	1	0	0.00
Glaucous-winged Gull	0	0	0.00
American Robin	1	1	1.27
European Starling	2	0	0.00
Vesper Sparrow	1	1	0.64
Savannah Sparrow	2	2	1.27
White-crowned Sparrow	1	1	0.64
House Finch	1	1	0.64
American Goldfinch	0	0	0.00
All Species Pooled			**4.46**

Table 14. Summary results from 1 point count in Beach habitat. All species detected during the Beach point count are listed, including species detected only as flyovers. 'No. of Points with Detections' excludes flyovers; values of zero indicate species that were detected only as flyovers. 'No. Points with 50-m Radius Detections' excludes flyovers and individuals estimated to be greater than 50 m from the observer. 'Individuals Detected per Hectare' is based on the average number of birds detected within a 50 m radius.

Species	No. Points with Detections	No. Points with 50-m Radius Detections	Individuals Detected per Hectare
Bald Eagle	1	0	0.00
Savannah Sparrow	1	1	1.27
All Species Pooled			**1.27**

Table 15. Summary results from 1 point count in Developed Area habitat. All species detected during the Developed Area point count are listed, including species detected only as flyovers. 'No. of Points with Detections' excludes flyovers; values of zero indicate species that were detected only as flyovers. 'No. Points with 50-m Radius Detections' excludes flyovers and individuals estimated to be greater than 50 m from the observer. 'Individuals Detected per Hectare' is based on the average number of birds detected within a 50 m radius.

Species	No. Points with Detections	No. Points with 50-m Radius Detections	Individuals Detected per Hectare
Canada Goose	1	1	10.19
Glaucous-winged Gull	1	1	1.27
Pileated Woodpecker	1	0	0.00
Warbling Vireo	1	0	0.00
Red-breasted Nuthatch	1	0	0.00
Swainson's Thrush	1	0	0.00
American Robin	1	1	2.55
European Starling	1	1	2.55
Common Yellowthroat	1	0	0.00
Spotted Towhee	1	0	0.00
Song Sparrow	1	0	0.00
White-crowned Sparrow	1	0	0.00
Brown-headed Cowbird	1	0	0.00
All Species Pooled			**16.56**

Table 16. Apparent density (birds per ha) of all species detected during at least one point count. Apparent density is based only on individuals detected within 50 m of the observer. Species with '--' indicated in all nine habitat columns were detected only as flyovers or at distances greater than 50 m.

Species	Douglas-fir	Mixed Conifer	Conifer Deciduous Mix	Red Alder	Shrub	Grassland	Sand Dune	Beach	Developed
Pacific Loon	--	--	--	--	--	--	--	--	--
Double-crested Cormorant	--	--	--	--	--	--	--	--	--
Canada Goose	--	--	--	--	--	--	--	--	10.19
Surf Scoter	--	--	--	--	--	--	--	--	--
White-winged Scoter	--	--	--	--	--	--	--	--	--
Red-breasted Merganser	--	--	--	--	--	--	--	--	--
Osprey	--	--	--	--	--	--	--	--	--
Bald Eagle	--	--	--	--	--	--	--	--	--
Northern Harrier	--	--	--	--	--	--	--	--	--
Red-tailed Hawk	--	0.07	--	--	--	0.03	--	--	--
Wild Turkey	--	--	--	--	--	--	--	--	--
California Quail	--	--	--	--	0.13	--	--	--	--
Black Oystercatcher	--	--	--	--	--	--	--	--	--
Glaucous-winged Gull	--	--	--	--	--	0.15	--	--	1.27
Band-tailed Pigeon	0.06	0.07	0.26	0.26	--	--	--	--	--
Rufous Hummingbird	0.19	0.21	0.26	0.26	0.60	0.21	--	--	--
Hairy Woodpecker	0.06	--	--	--	--	--	--	--	--
Northern Flicker	--	--	--	--	0.07	0.03	--	--	--
Pileated Woodpecker	0.06	0.07	--	--	0.07	--	--	--	--
Olive-sided Flycatcher	--	0.07	--	--	--	--	--	--	--
Willow Flycatcher	--	--	--	--	--	--	--	--	--
Pacific-slope Flycatcher	1.27	0.99	1.02	1.02	0.34	0.03	--	--	--
Cassin's Vireo	0.32	--	0.26	--	0.13	--	--	--	--
Hutton's Vireo	--	0.07	--	--	--	--	--	--	--

Table 16, cont.

Species	Douglas-fir	Mixed Conifer	Conifer Deciduous Mix	Red Alder	Shrub	Grass	Sand Dune	Beach	Developed
Warbling Vireo	--	--	0.51	0.26	--	--	--	--	--
American Crow	--	--	0.26	--	0.13	0.03	--	--	--
Common Raven	--	0.28	--	--	--	--	--	--	--
Tree Swallow	--	--	--	--	--	--	--	--	--
Violet-green Swallow	--	--	--	--	--	--	--	--	--
N. Rough-winged Swallow	--	0.07	--	--	--	--	--	--	--
Cliff Swallow	--	--	--	--	--	0.03	--	--	--
Barn Swallow	--	--	--	--	0.07	--	--	--	--
Chestnut-backed Chickadee	1.27	0.50	0.26	--	0.27	0.03	--	--	--
Bushtit	--	--	--	--	--	--	--	--	--
Red-breasted Nuthatch	0.45	0.07	--	--	0.07	--	--	--	--
Brown Creeper	0.00	0.14	0.26	--	0.07	--	--	--	--
Bewick's Wren	--	0.21	0.26	--	0.07	0.09	--	--	--
House Wren	0.13	0.14	--	--	0.13	0.09	--	--	--
Winter Wren	--	0.42	0.26	--	--	0.03	--	--	--
Marsh Wren	--	--	--	--	0.20	--	--	--	--
Golden-crowned Kinglet	0.13	0.64	0.51	0.26	--	--	--	--	--
Swainson's Thrush	0.26	0.42	1.78	1.02	0.74	0.03	--	--	--
American Robin	0.70	1.13	0.51	1.78	1.07	0.21	1.27	--	2.55
European Starling	--	--	--	--	--	0.03	--	--	2.55
Cedar Waxwing	--	0.14	--	0.76	0.27	--	--	--	--
Orange-crowned Warbler	0.45	0.35	--	0.26	0.27	0.12	--	--	--
Yellow Warbler	--	--	--	--	0.07	--	--	--	--
Yellow-rumped Warbler	0.06	0.07	0.26	--	0.13	--	--	--	--
Black-throated Gray Warbler	0.13	0.14	--	--	0.07	--	--	--	--
Townsend's Warbler	0.26	0.07	--	--	--	--	--	--	--

Table 16, cont.

Species	Douglas-fir	Mixed Conifer	Conifer Deciduous Mix	Red Alder	Shrub	Grass	Sand Dune	Beach	Developed
MacGillivray's Warbler	--	--	--	--	0.13	--	--	--	--
Common Yellowthroat	--	--	--	--	0.20	--	--	--	--
Wilson's Warbler	0.06	--	--	0.26	--	--	--	--	--
Western Tanager	0.19	--	--	--	0.13	0.06	--	--	--
Spotted Towhee	1.27	1.06	0.76	0.51	0.87	0.09	--	--	--
Chipping Sparrow	0.32	--	--	--	0.07	0.09	--	--	--
Vesper Sparrow	--	--	--	--	--	0.03	0.64	--	--
Savannah Sparrow	--	--	--	--	0.07	1.39	1.27	1.27	--
Song Sparrow	0.19	0.35	1.02	0.51	0.40	0.06	--	--	--
White-crowned Sparrow	0.26	0.28	--	--	0.40	0.46	0.64	--	--
Dark-eyed Junco	0.45	0.21	--	--	0.07	0.03	--	--	--
Black-headed Grosbeak	--	--	--	--	--	--	--	--	--
Red-winged Blackbird	--	--	--	--	1.07	0.06	--	--	--
Brewer's Blackbird	--	--	--	--	--	0.03	--	--	--
Brown-headed Cowbird	0.38	0.64	--	0.76	0.94	0.09	--	--	--
Purple Finch	0.06	0.14	--	--	--	--	--	--	--
House Finch	--	0.14	--	--	0.40	0.39	0.64	--	--
Red Crossbill	0.45	0.57	--	0.26	--	--	--	--	--
Pine Siskin	0.19	0.78	--	--	0.27	0.12	--	--	--
American Goldfinch	0.13	0.14	0.26	0.51	0.67	0.36	--	--	--

Table 17. Apparent density estimates (based on 50 m radius detections and uncorrected for detectability) and program Distance density estimates (corrected for detectability) in forested habitats for all species with at least 40 detections in those habitats.

Species and Habitat	Naive Estimate Birds/ha	DISTANCE-based Estimate Birds/ha	CV	df	95% C. I.
Pacific-slope Flycatcher					
Douglas-fir	1.27	2.96	18.8	80	(2.04, 4.29)
Mixed Conifer	0.99	2.40	25.8	46	(1.44, 4.01)
Conif./Decid. Mix	1.02	2.28	17.0	62	(1.63, 3.19)
Red Alder	1.02	3.65	22.9	18	(2.27, 5.85)
Shrub	0.34	0.72	38.6	28	(0.33, 1.55)
Swainson's Thrush					
Douglas-fir	0.26	1.01	33.5	36	(0.52, 1.95)
Mixed Conifer	0.42	0.93	31.8	35	(0.50, 1.75)
Conif./Decid. Mix	1.78	3.36	24.1	19	(2.05, 5.52)
Red Alder	1.02	3.03	21.3	35	(1.97, 4.64)
Shrub	0.74	1.06	28.3	45	(0.61, 1.86)
American Robin					
Douglas-fir	0.70	3.16	24.0	47	(1.97, 5.09)
Mixed Conifer	1.13	3.39	23.2	45	(2.13, 5.37)
Conif./Decid. Mix	0.51	4.22	18.5	28	(2.89, 6.15)
Red Alder	1.78	5.16	36.6	6	(2.15, 12.39)
Shrub	1.07	3.70	20.9	62	(2.45, 5.60)
Orange-crowned Warbler					
Douglas-fir	0.45	0.64	36.4	54	(0.31, 1.29)
Mixed Conifer	0.35	0.38	41.2	51	(0.17, 0.84)
Conif./Decid. Mix	--	0.51	51.3	10	(0.17, 1.50)
Red Alder	0.26	0.17	104.7	5	(0.02, 1.59)
Shrub	0.27	0.58	38.3	54	(0.28, 1.22)

Table 17, cont.

Habitat	Naive Estimate	DISTANCE-based Estimate			
	Birds/ha	Birds/ha	Habitat	Birds/ha	Birds/ha
Spotted Towhee					
Douglas-fir	1.27	7.86	28.6	51	(4.48, 13.80)
Mixed Conifer	1.06	7.07	30.2	42	(3.90, 12.84)
Conif./Decid. Mix	0.76	4.49	69.3	5	(0.87, 23.26)
Red Alder	0.51	3.00	64.1	5	(0.65, 13.79)
Shrub	0.87	5.91	29.8	45	(3.29, 10.64)
Brown-headed Cowbird					
Douglas-fir	0.38	1.65	37.6	28	(0.78, 3.47)
Mixed Conifer	0.64	1.83	33.9	27	(0.93, 3.60)
Conif./Decid. Mix	--	--			
Red Alder	0.76	1.98	68.5	5	(0.38, 10.34)
Shrub	0.94	2.95	40.4	25	(1.32, 6.57)

Table 18. Apparent density estimates (based on 50 m radius detections and uncorrected for detectability) and program Distance density estimates in Grassland habitat for all species with at least 40 detections in open habitats. Values for the three other open habitats, Sand Dune, Beach, and Developed Area are not presented because no more than 2 point counts were conducted in any of them.

Species	Naive Estimate	DISTANCE-based Estimate			
	Birds/ha	Birds/ha	CV	df	95% C. I.
European Starling	0.03	0.12	62.1	47	(0.04, 0.38)
Savannah Sparrow	1.39	6.44	22.4	110	(4.15, 9.99)
White-crowned Sparrow	0.46	0.49	24.1	86	(0.31, 0.79)
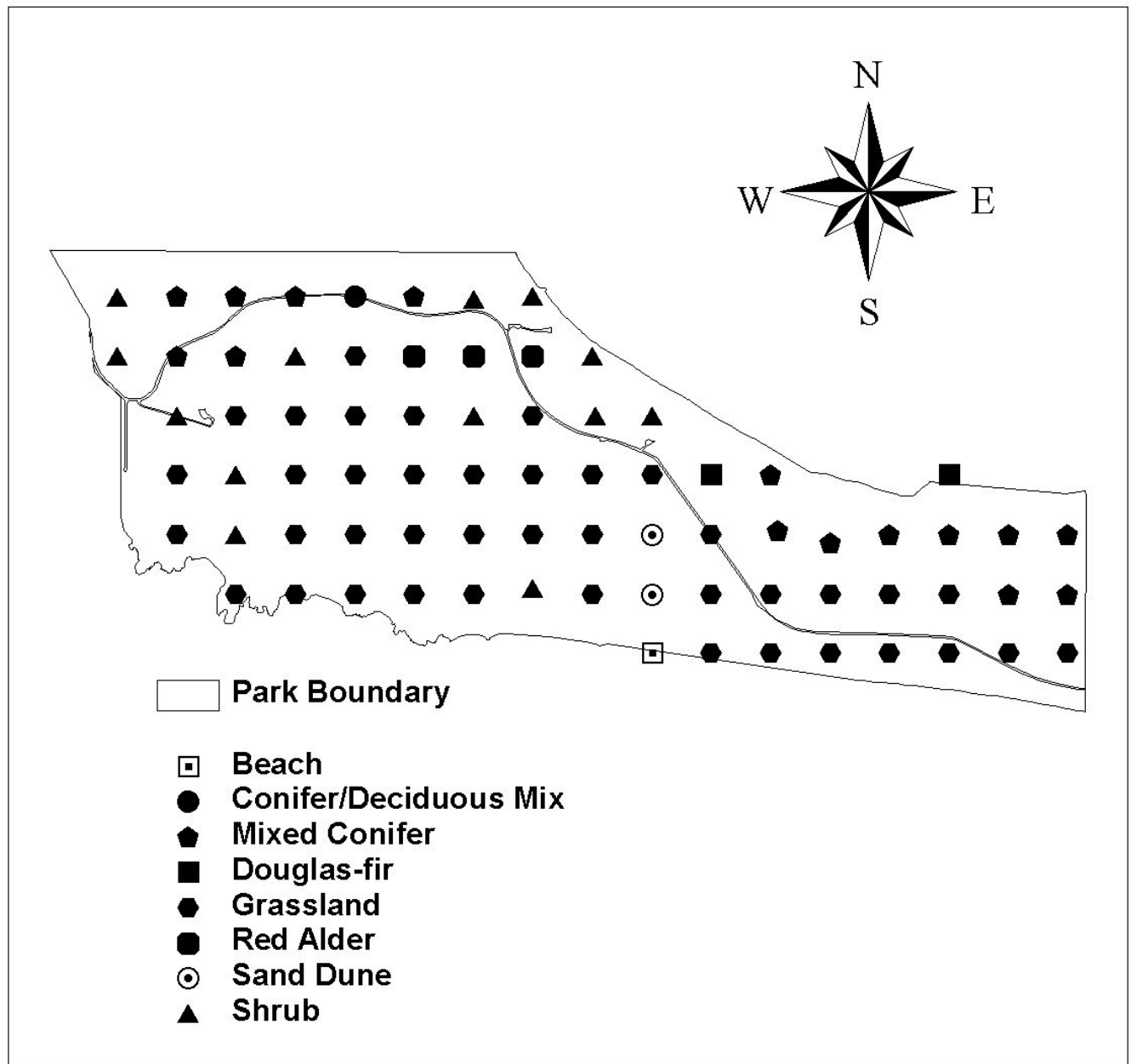
Figure 1. Field-based habitat classifications of point count locations at American Camp.
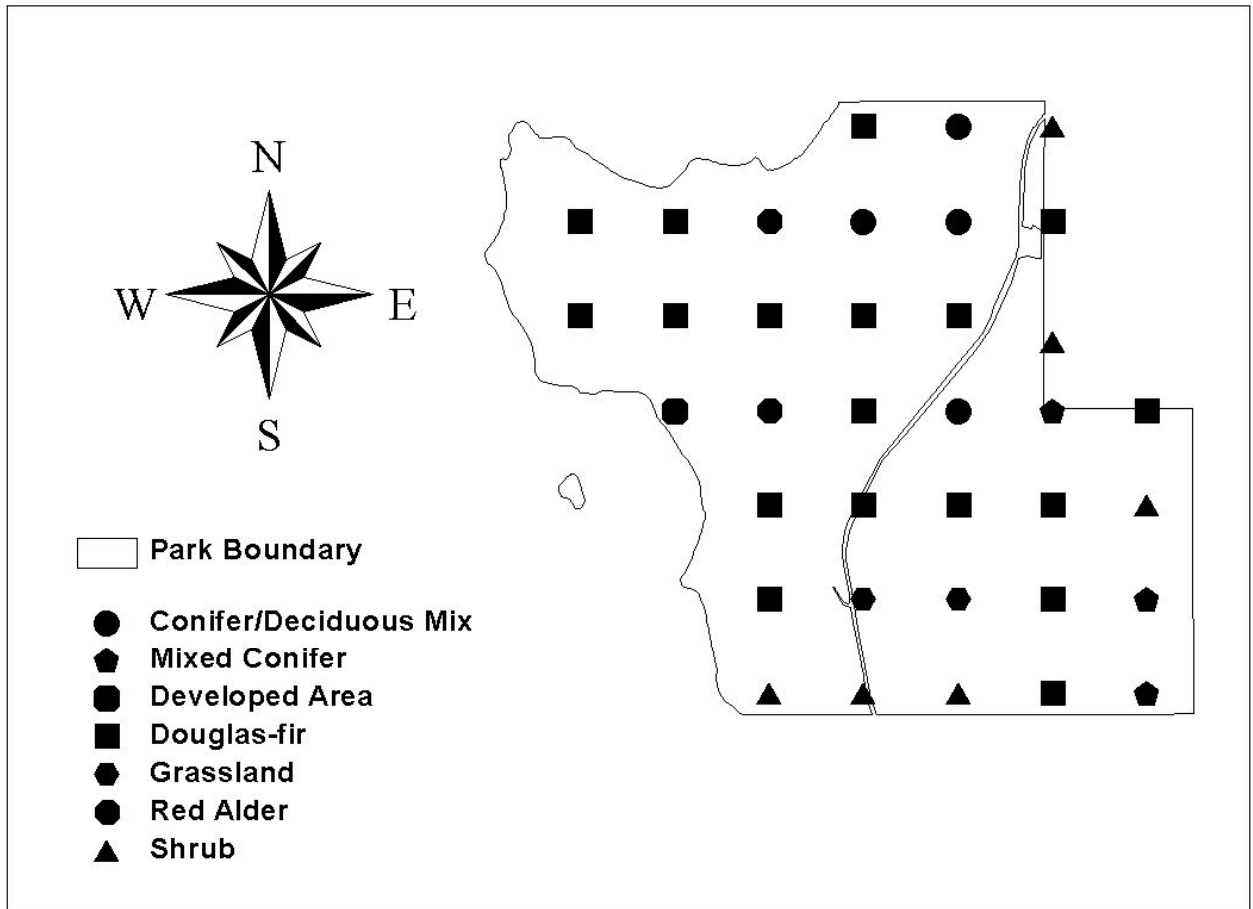
Figure 2. Field-based habitat classifications of point count locations at English Camp.

Pacific Loon
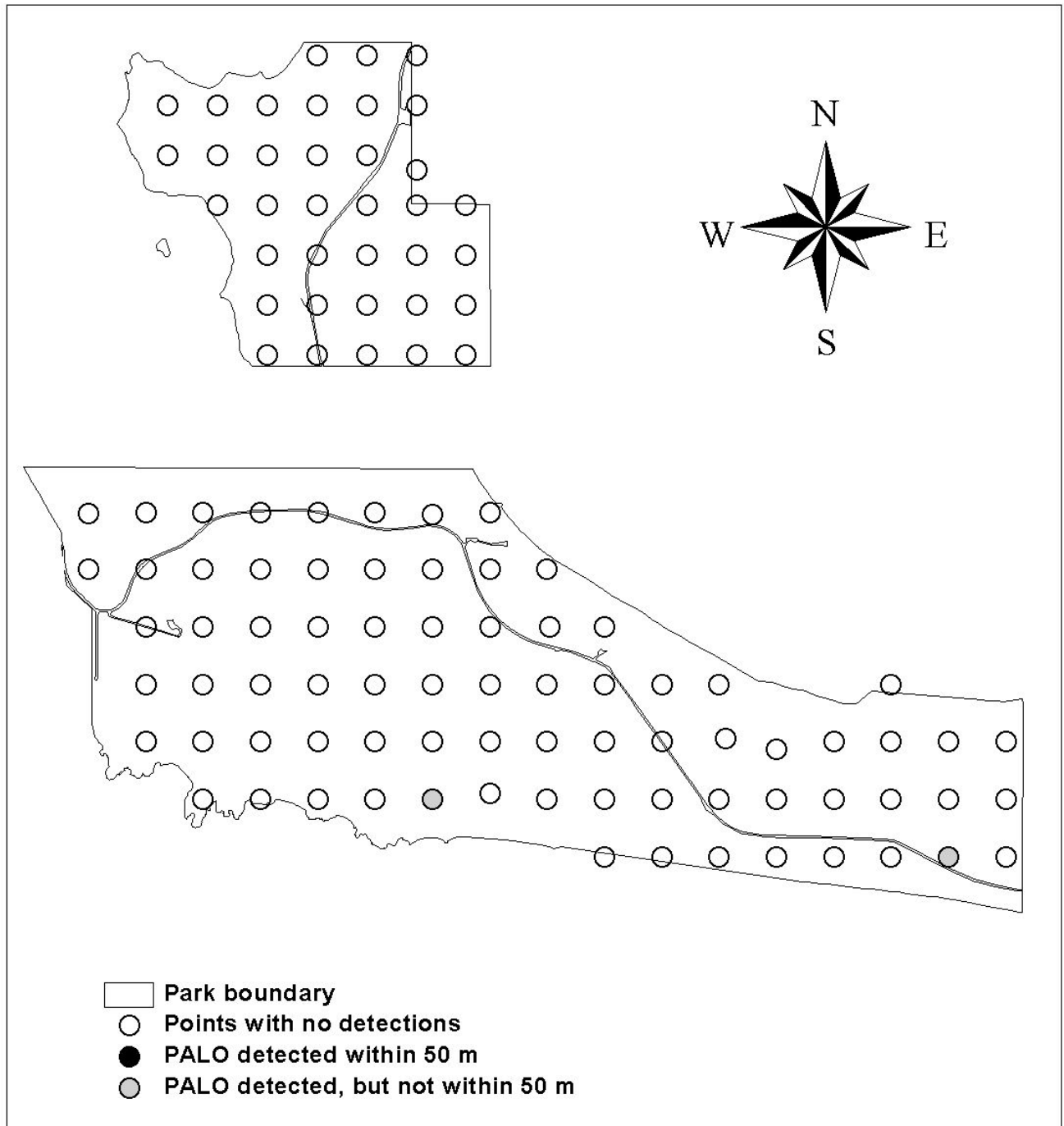
Figure 3. Pacific Loon point count detections.

Double-crested Cormorant
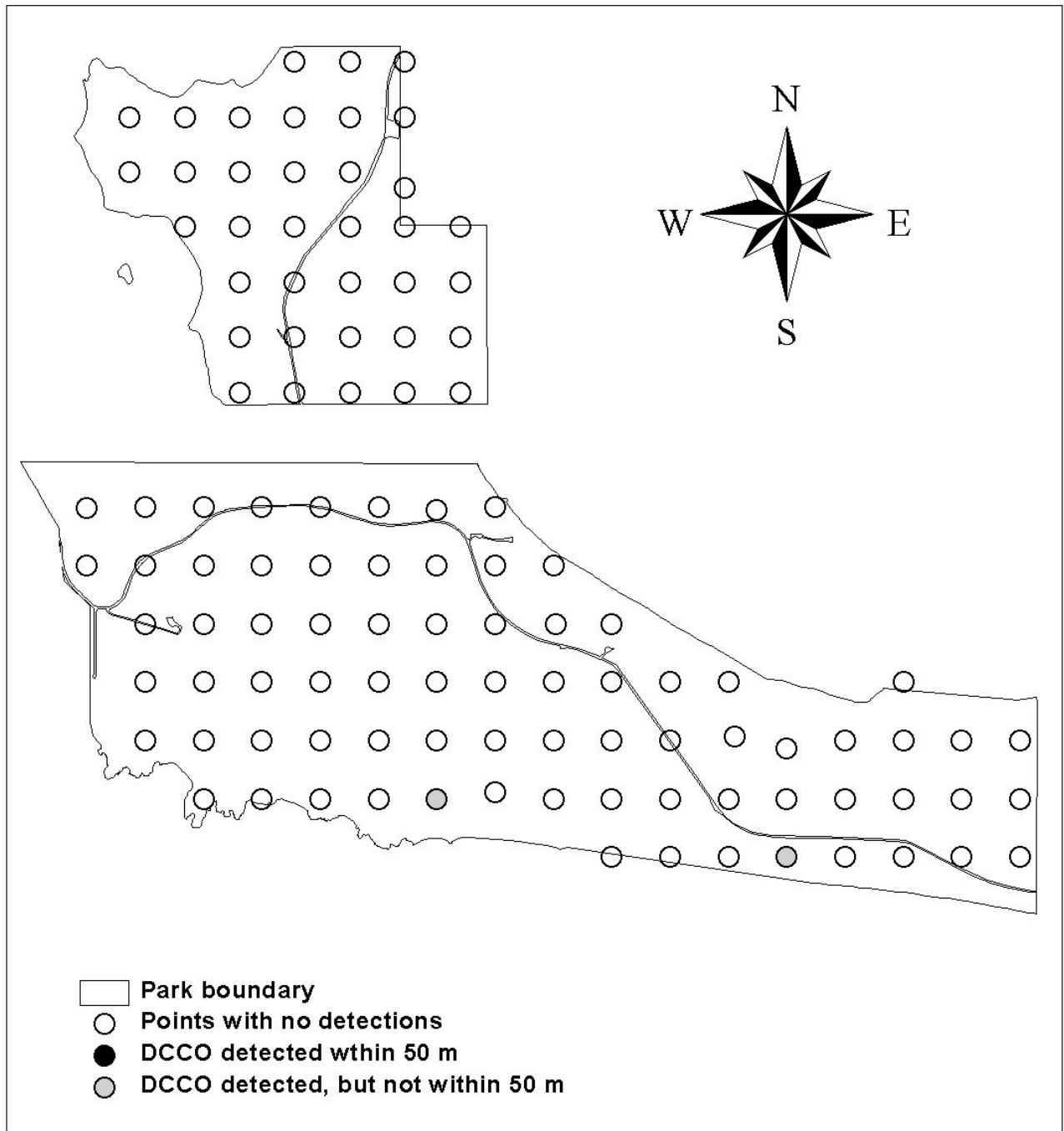
Figure 4. Double-crested Cormorant point count detections.

Canada Goose

Park boundary
○ Points with no detections
● CAGO detected within 50 m
◐ CAGO detected, but not within 50 m
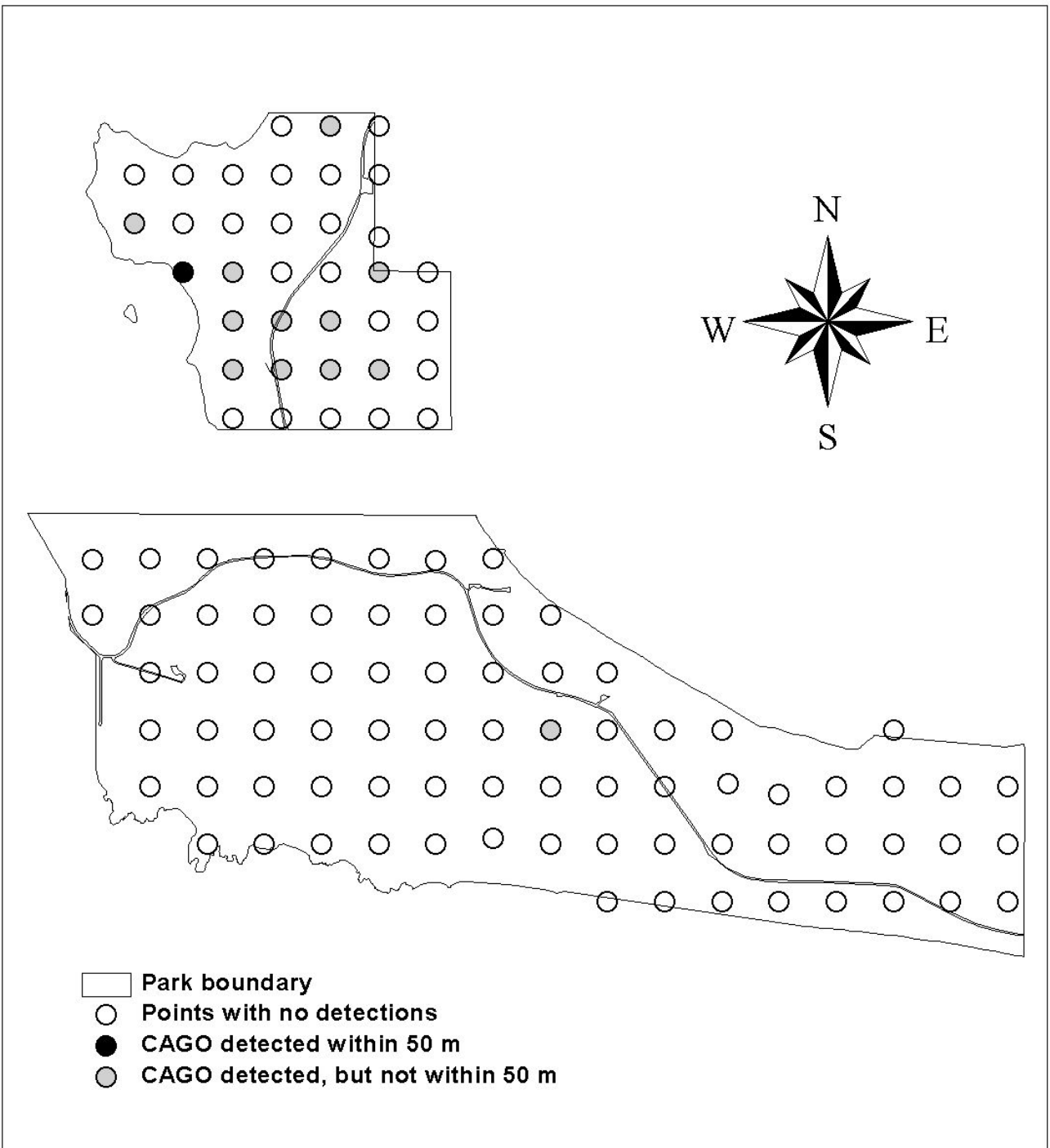
Figure 5. Canada Goose point count detections.

Surf Scoter
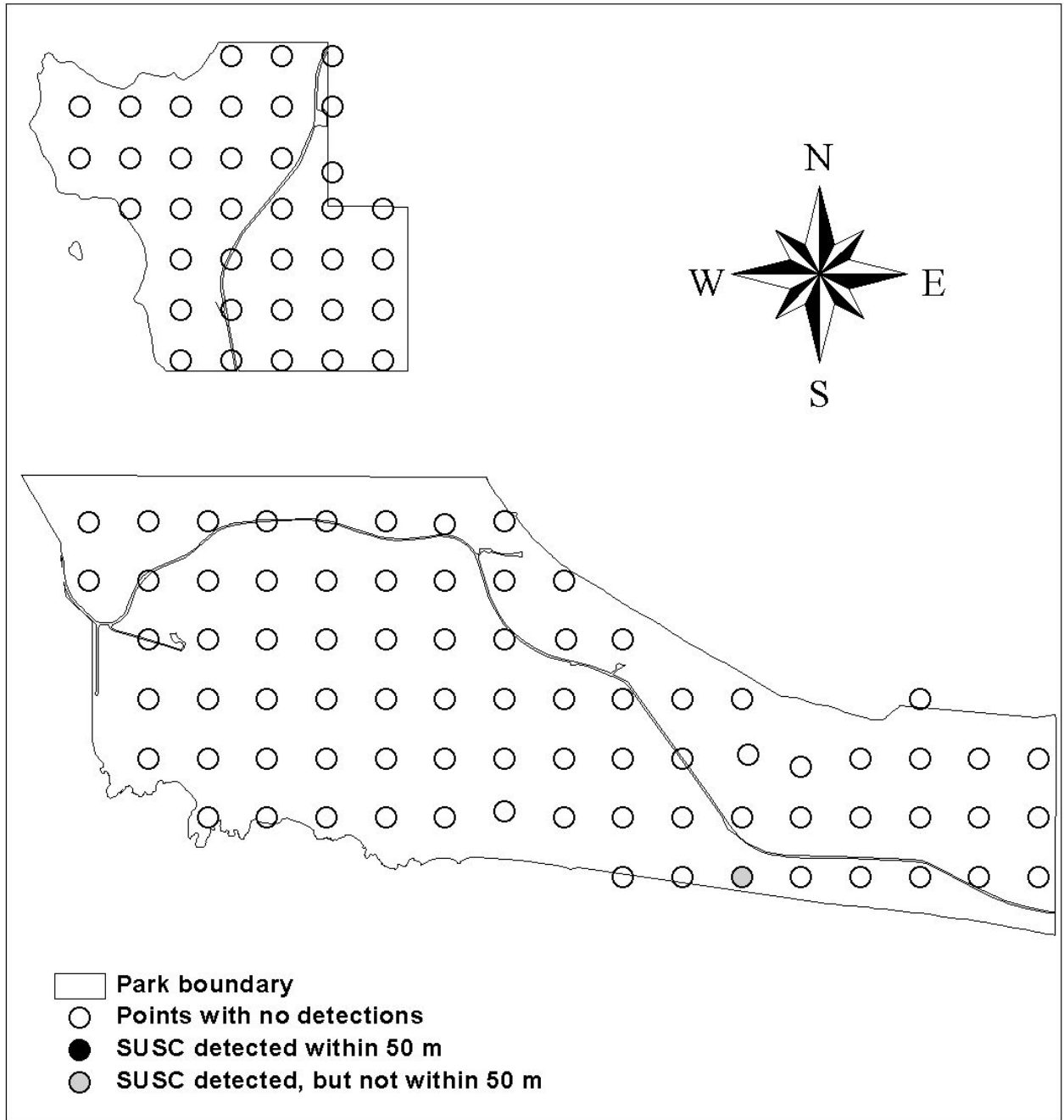
Figure 6. Surf Scoter point count detections.

White-winged Scoter
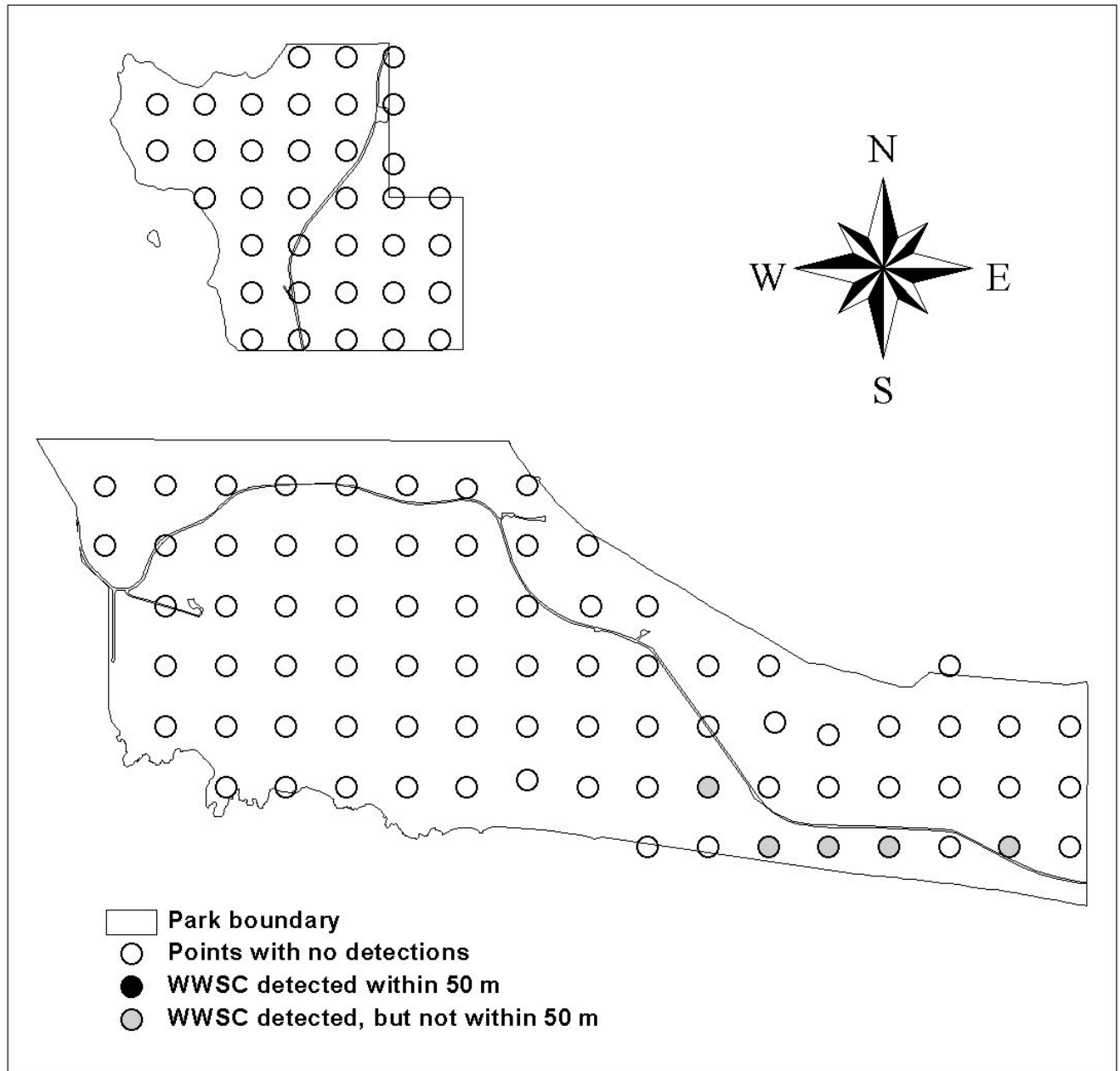
Figure 7. White-winged Scoter point count detections.

Red-breasted Merganser
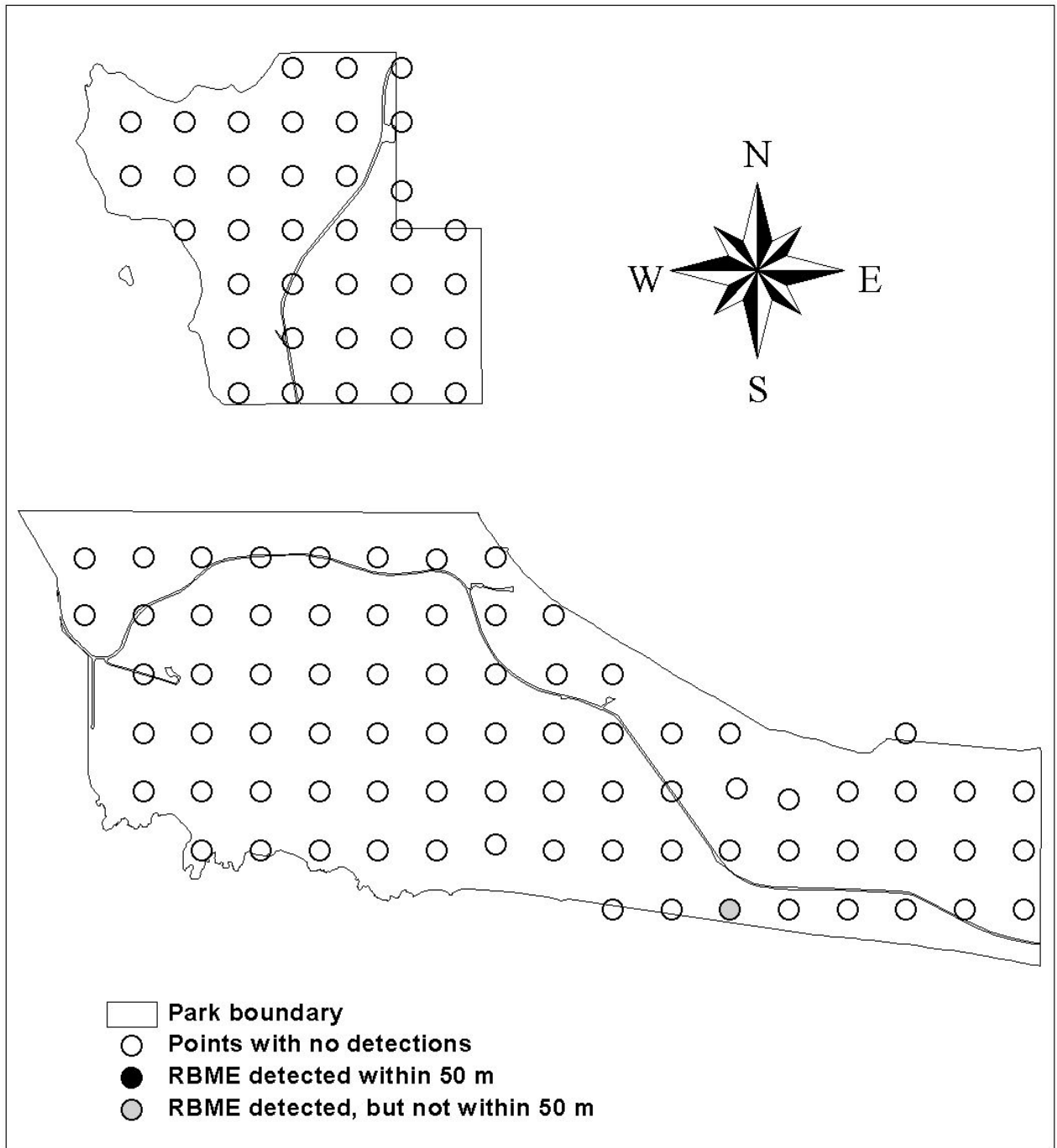
Figure 8. Red-breasted Merganser point count detections.

Osprey
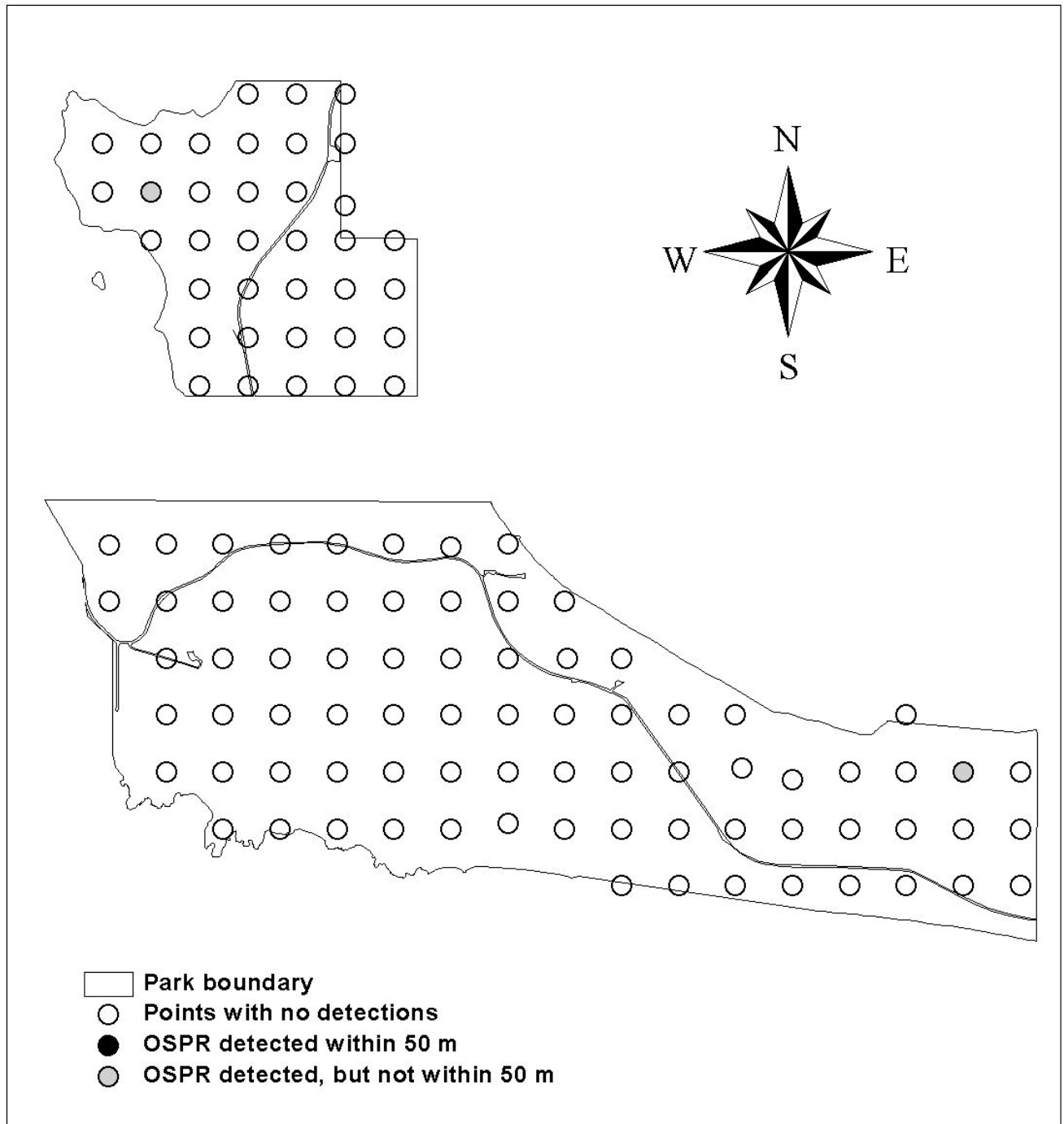
Figure 9. Osprey point count detections.

44
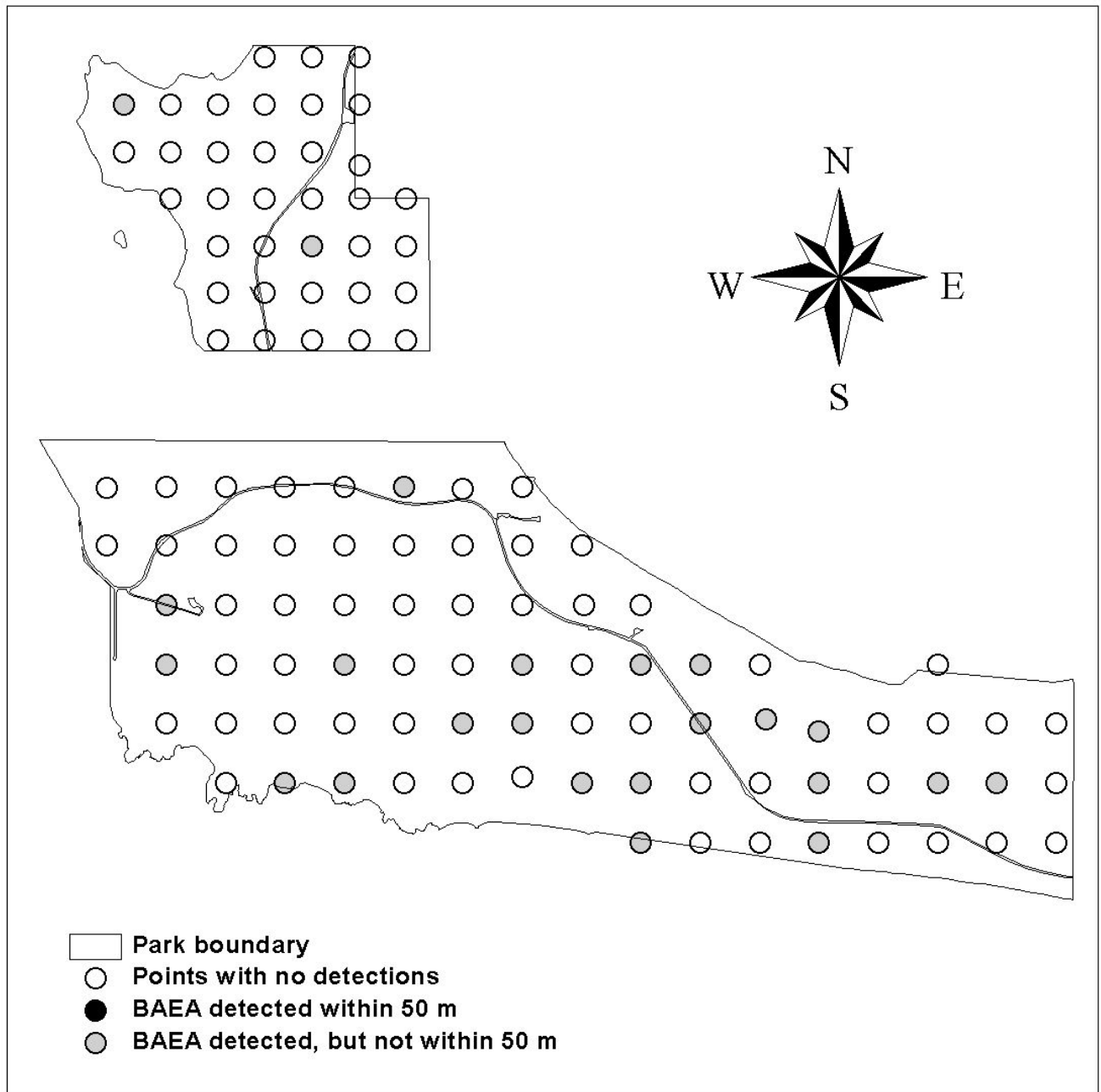
Bald Eagle

Figure 10. Bald Eagle point count detections.

Northern Harrier
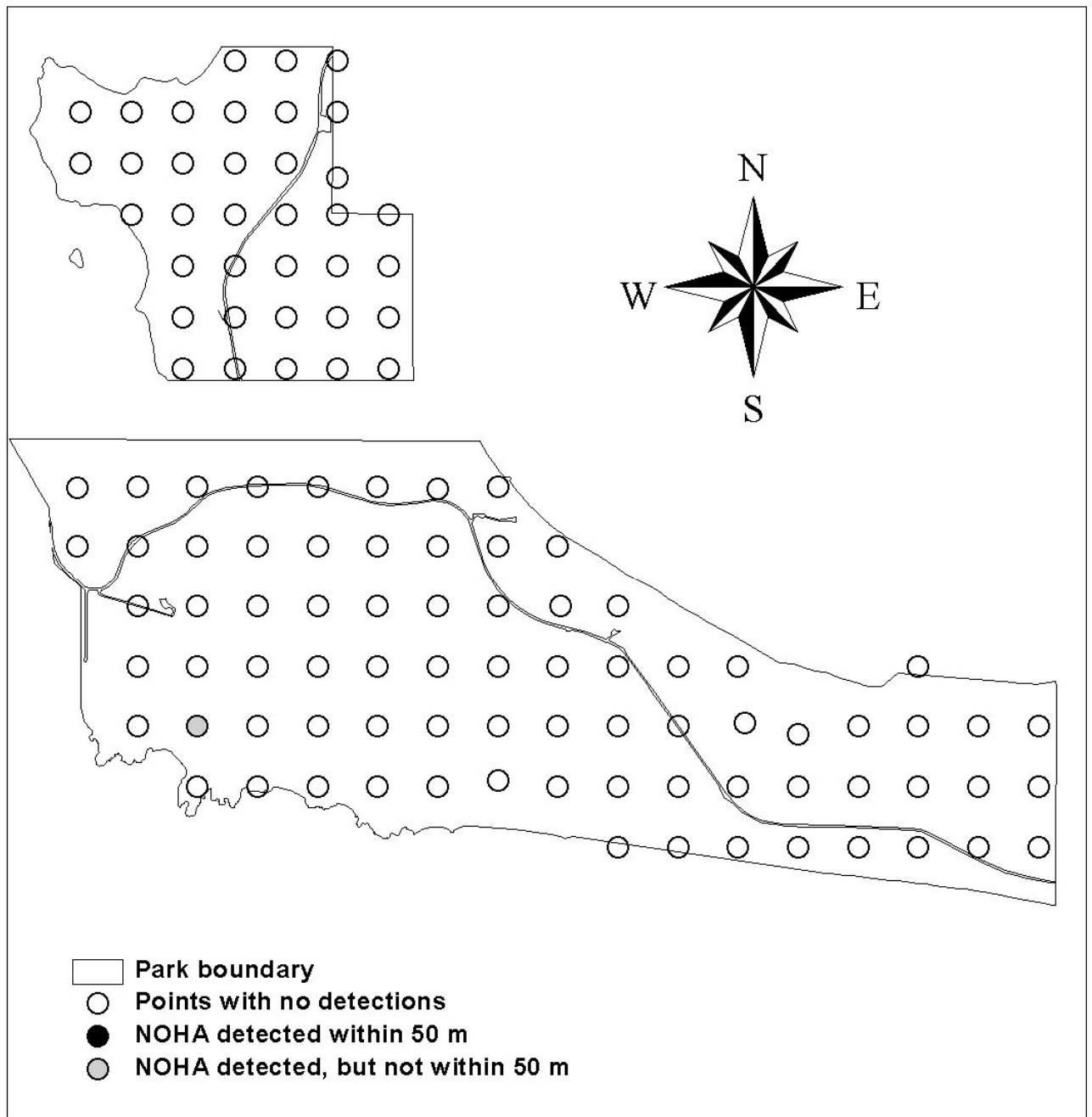
Figure 11. Norther Harrier point count detections.

Red-tailed Hawk
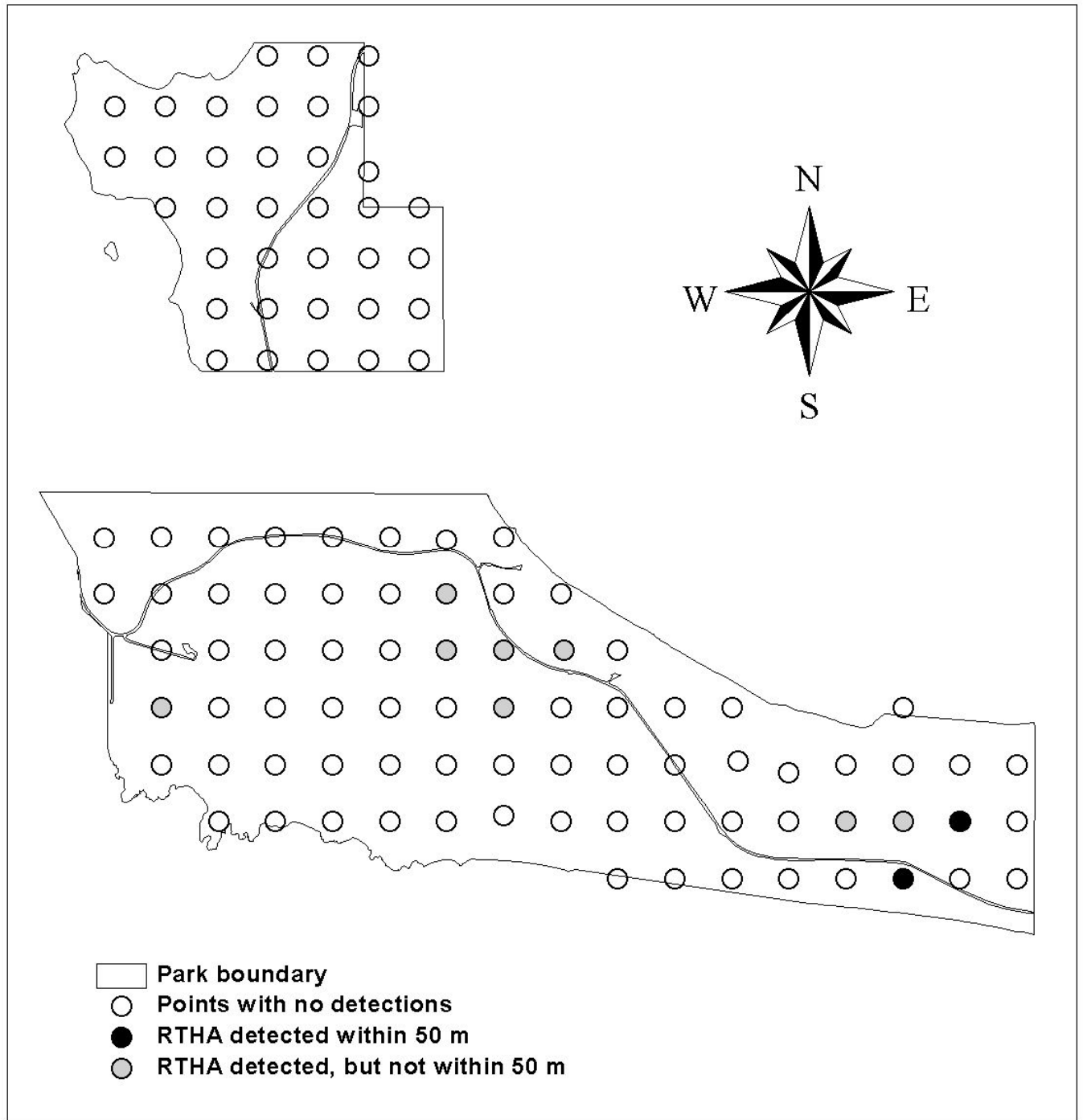
Figure 12. Red-tailed Hawk point count detections.

Wild Turkey
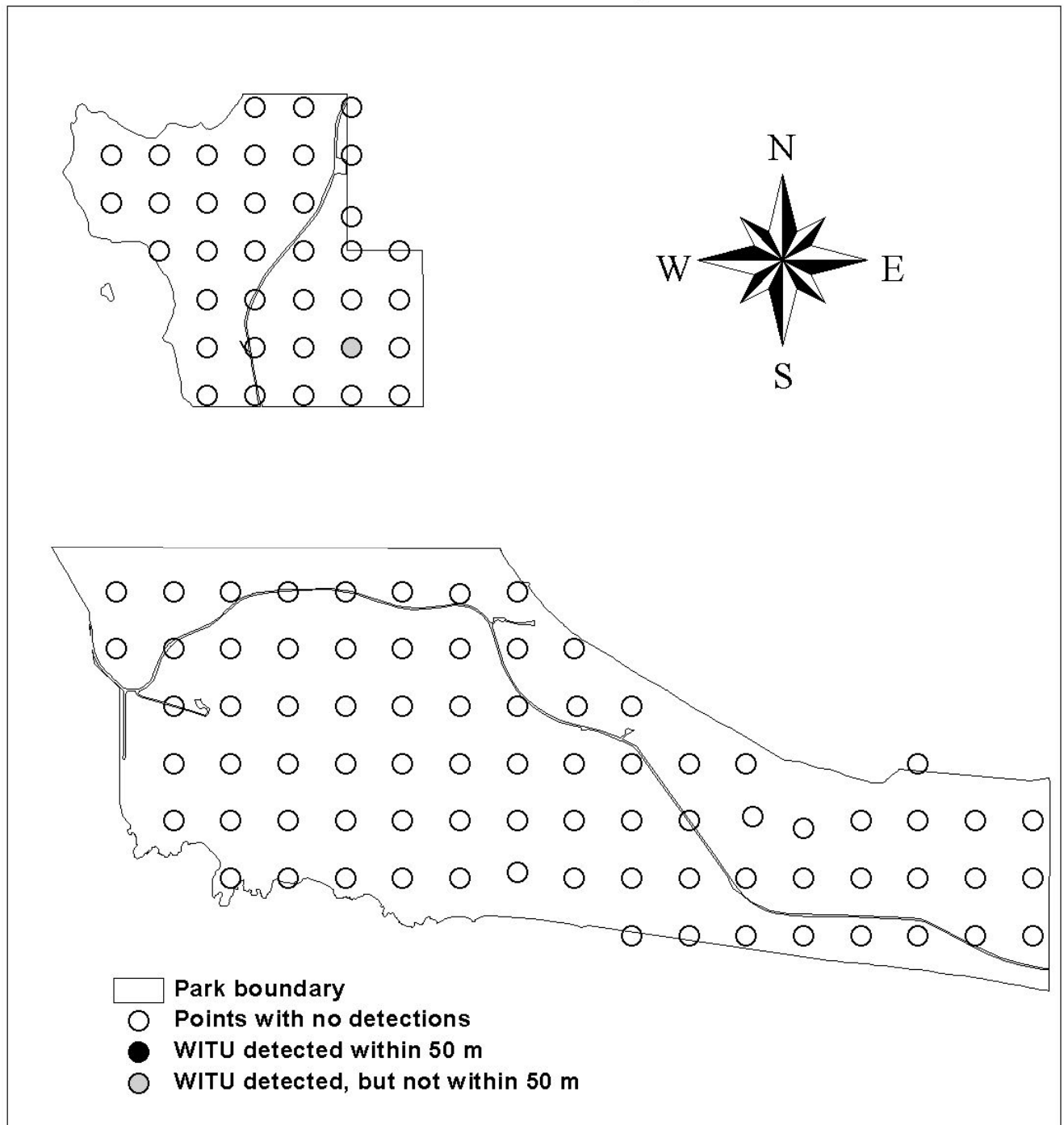
Figure 13. Wild Turkey point count detections.

48
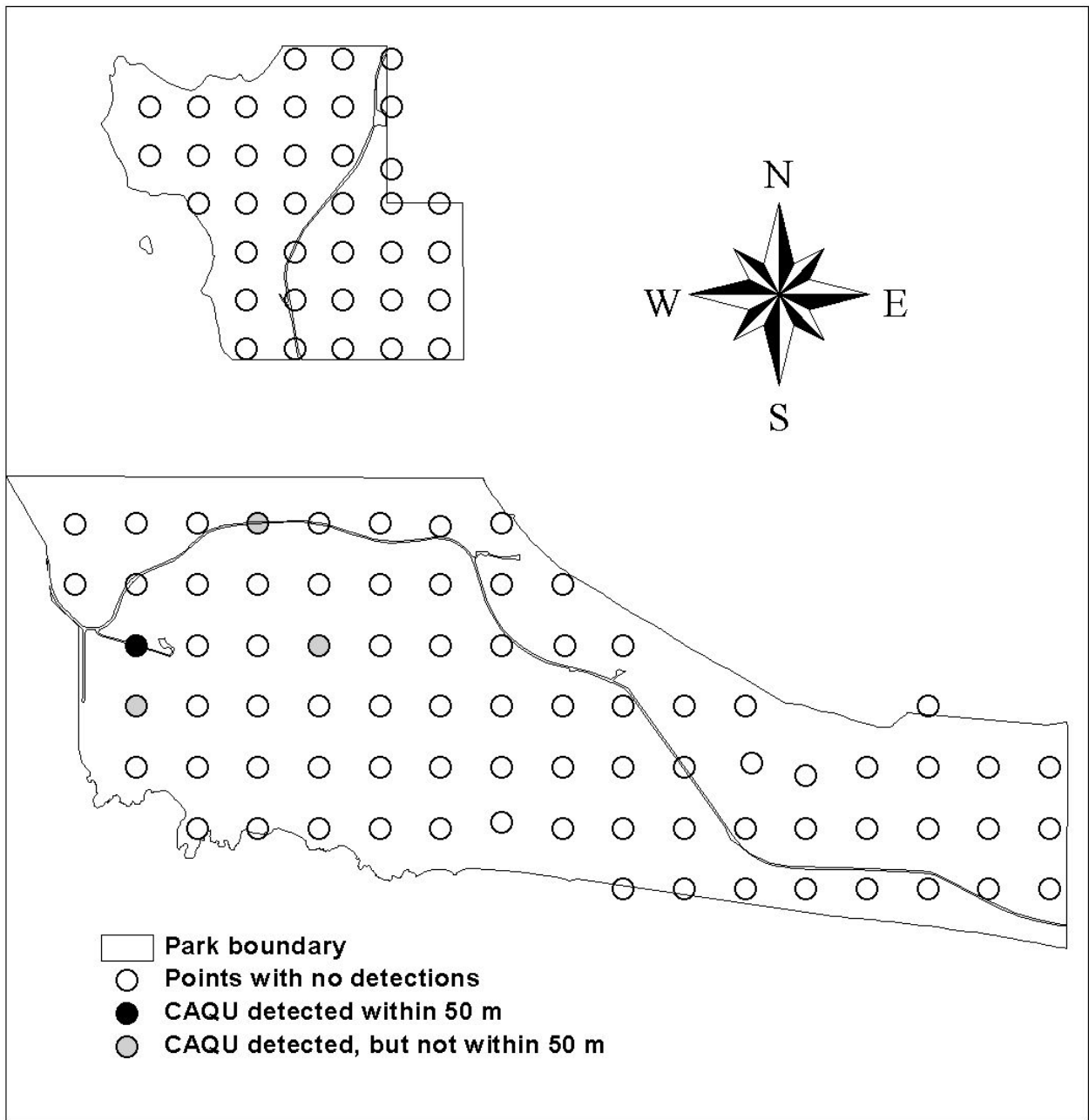
California Quail

Figure 14. California Quail point count detections.

Black Oystercatcher
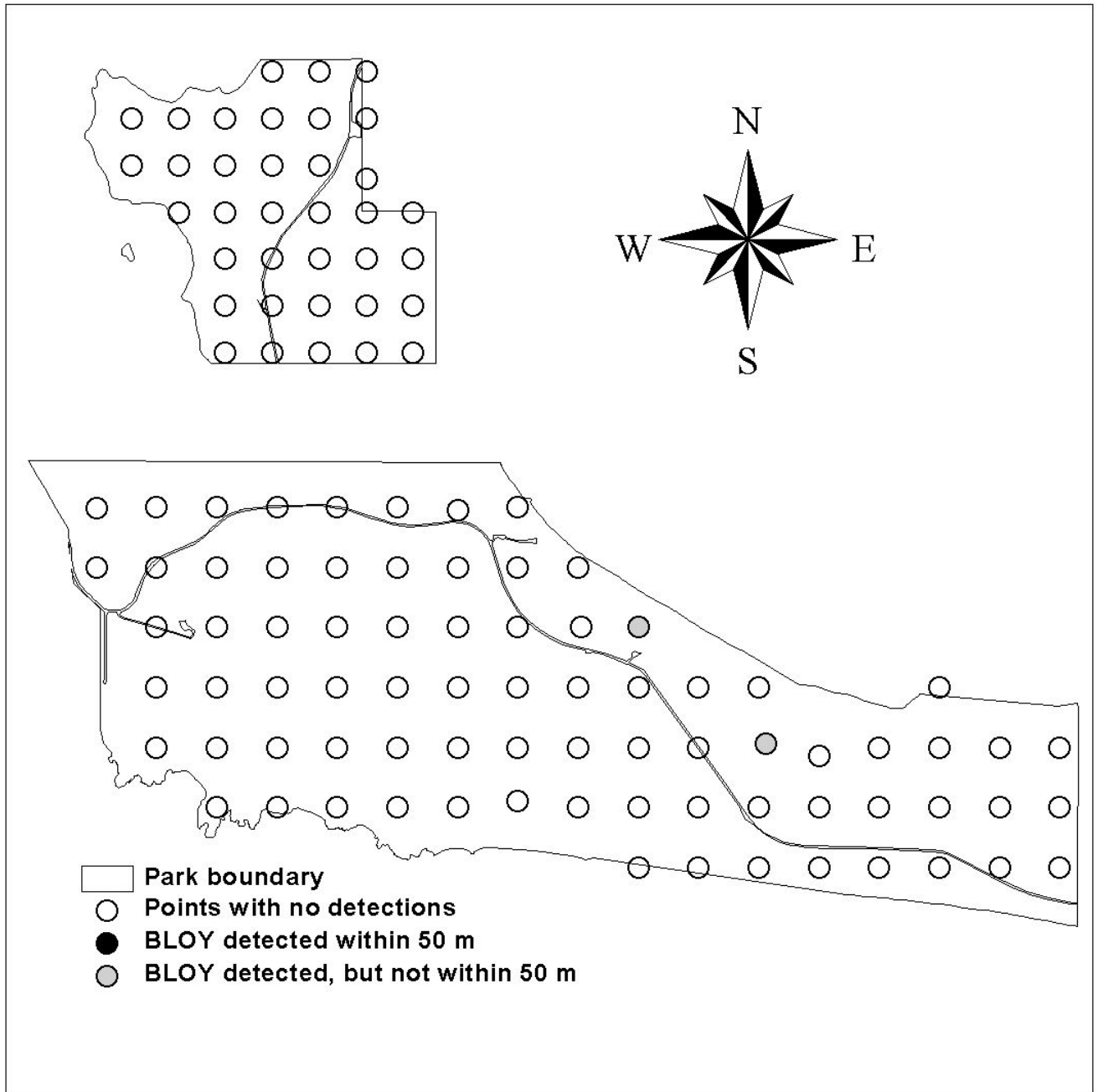
Figure 15. Black Oystercatcher point count detections.

Glaucous-winged Gull
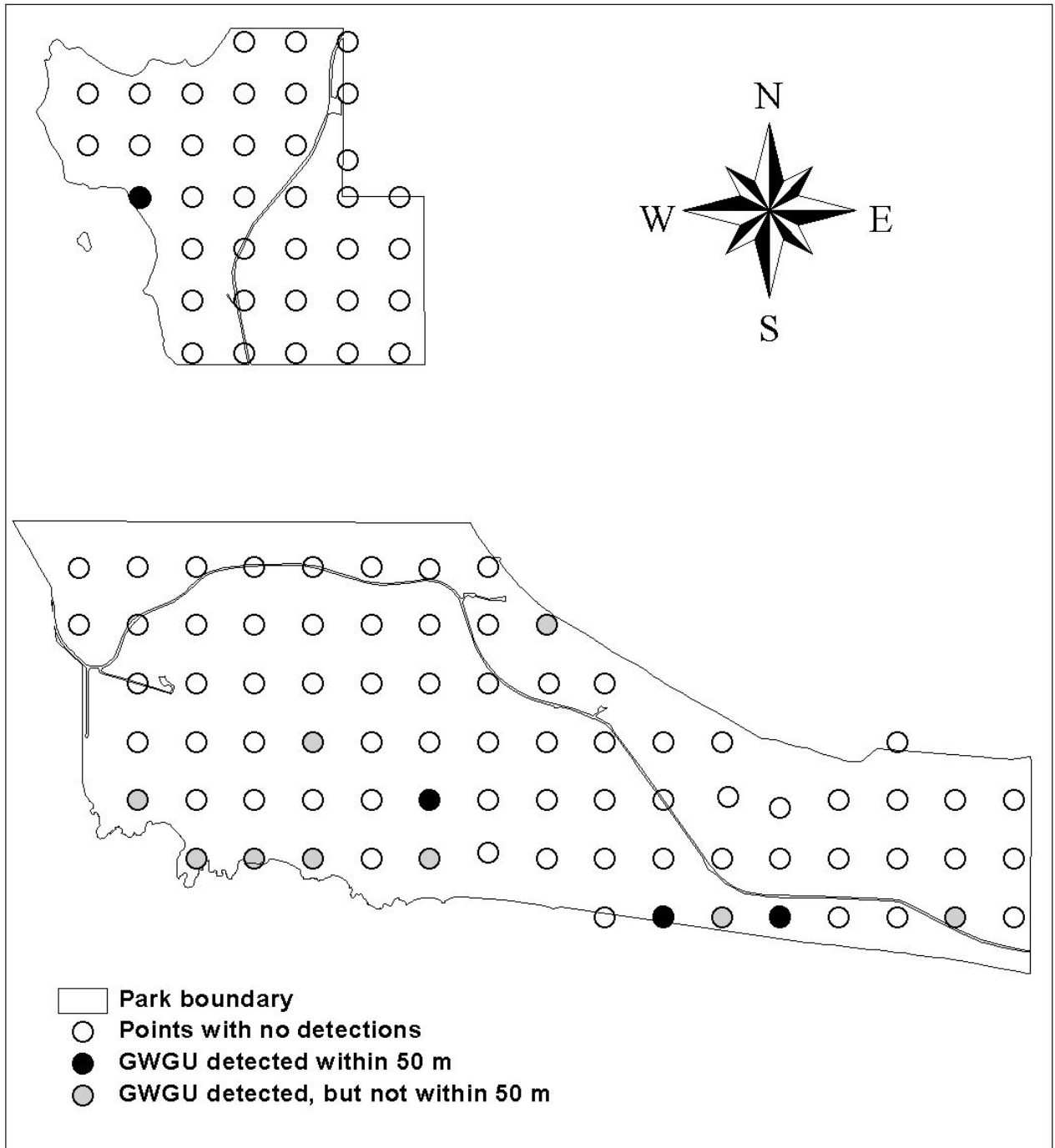
Figure 16. Glaucus-winged Gull point count detections.

Band-tailed Pigeon
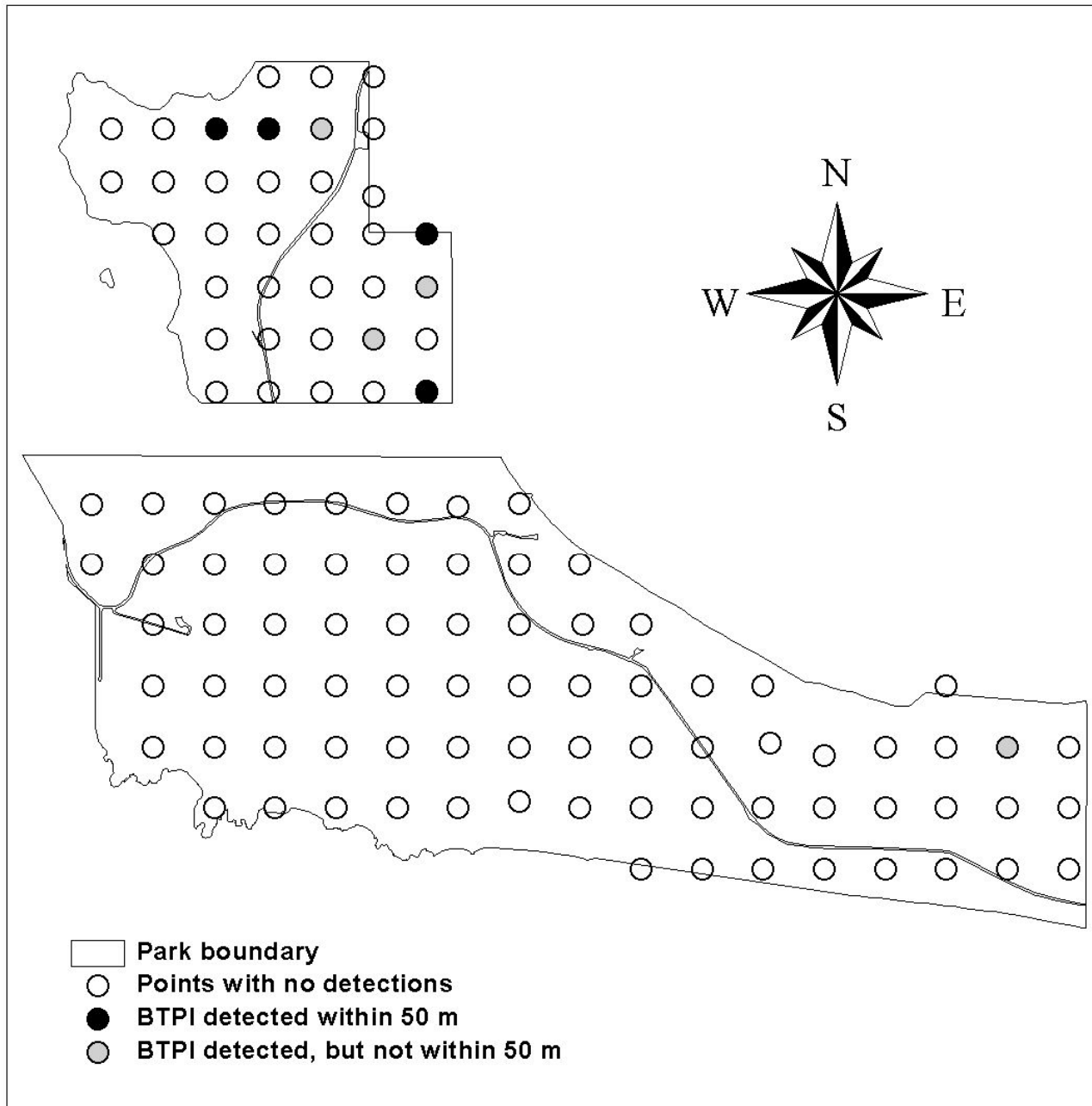
Figure 17. Band-tailed Pigeon point count detections.

Rufous Hummingbird
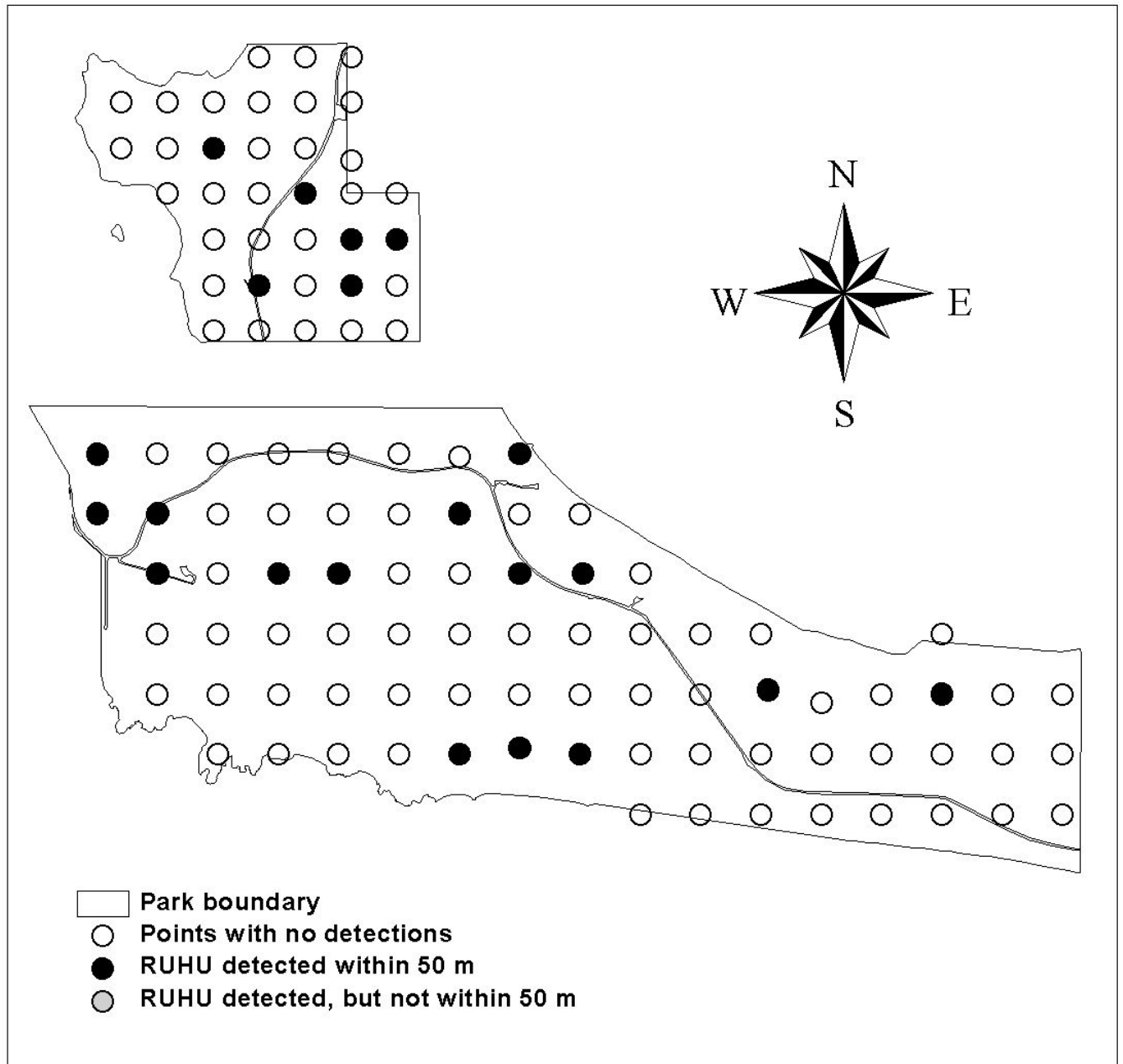
Figure 18. Rufous Hummingbird point count detections.

Hairy Woodpecker
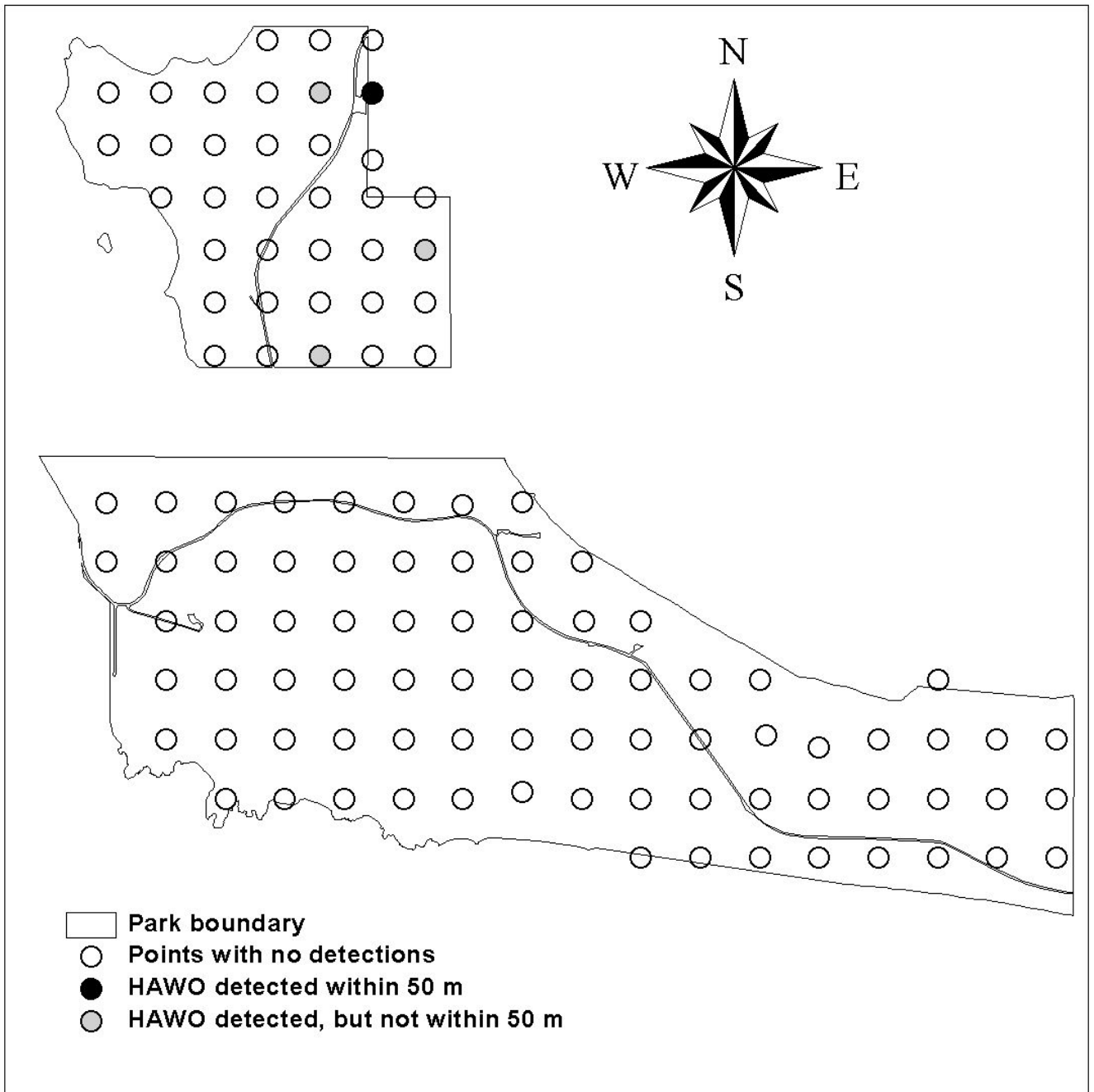
Figure 19. Hairy Woodpecker point count detections.

Northern Flicker
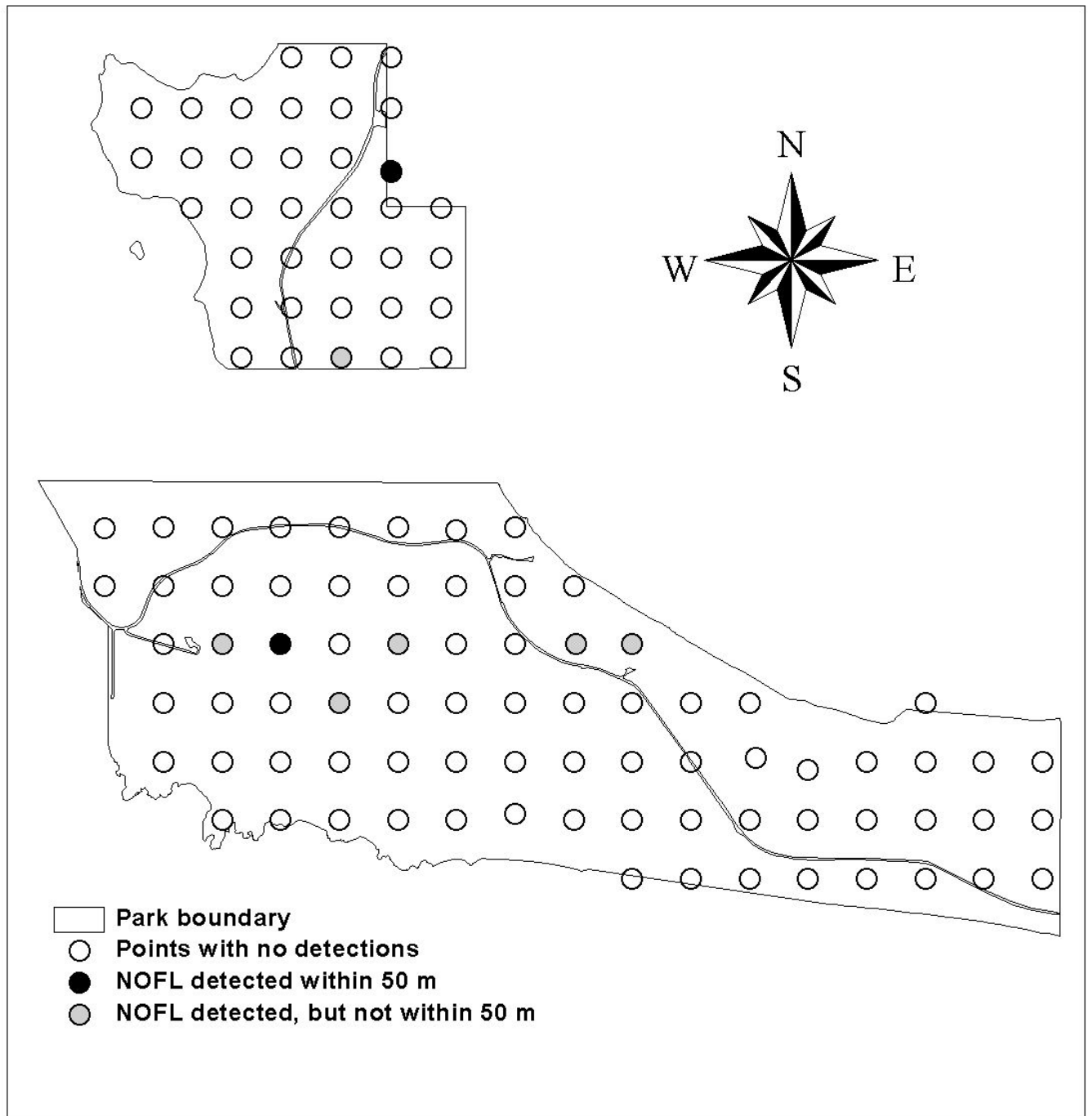
Figure 20. Northern Flicker point count detections.

Pileated Woodpecker
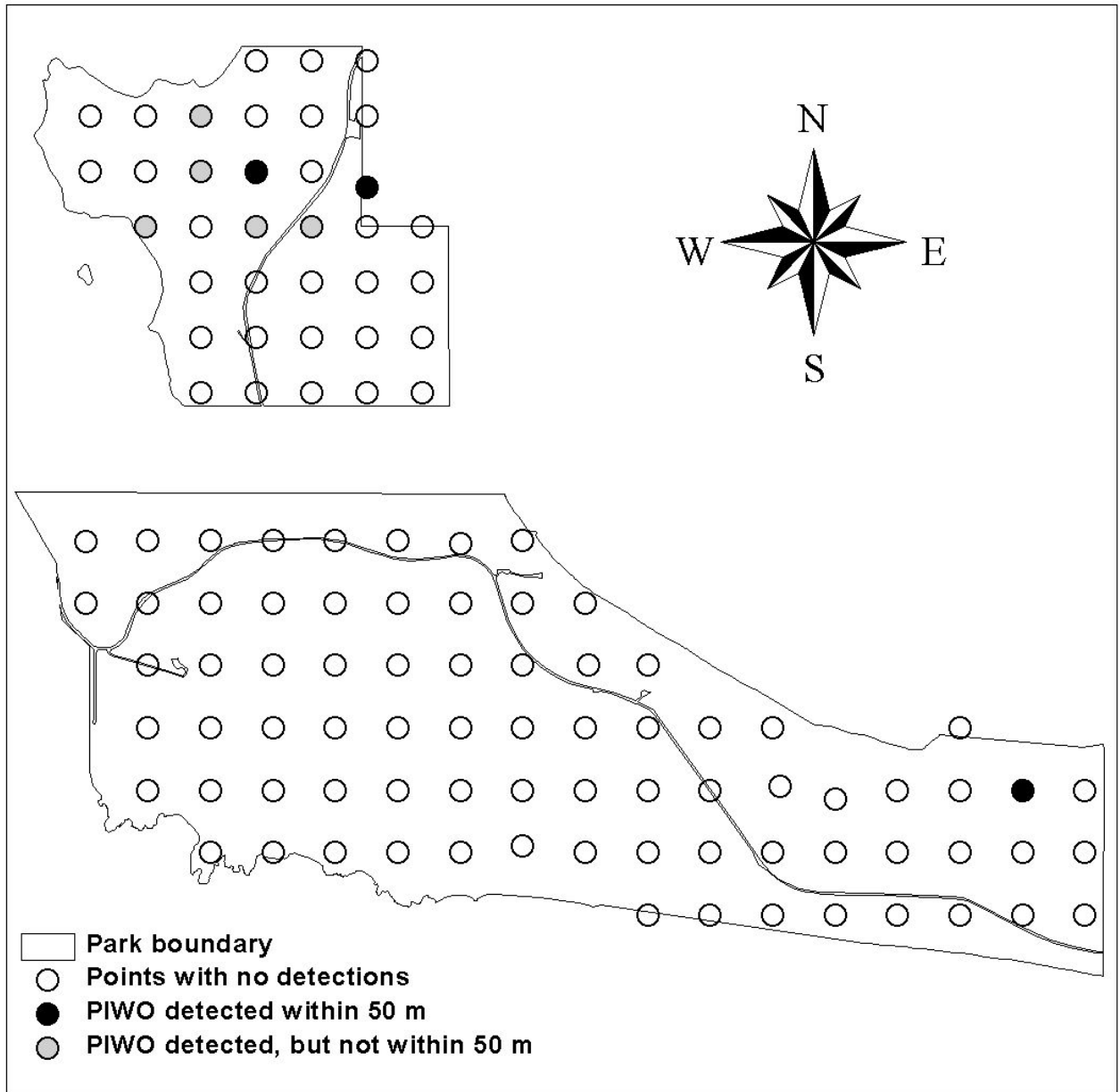
Figure 21. Pileated Woodpecker point count detections.

Olive-sided Flycatcher
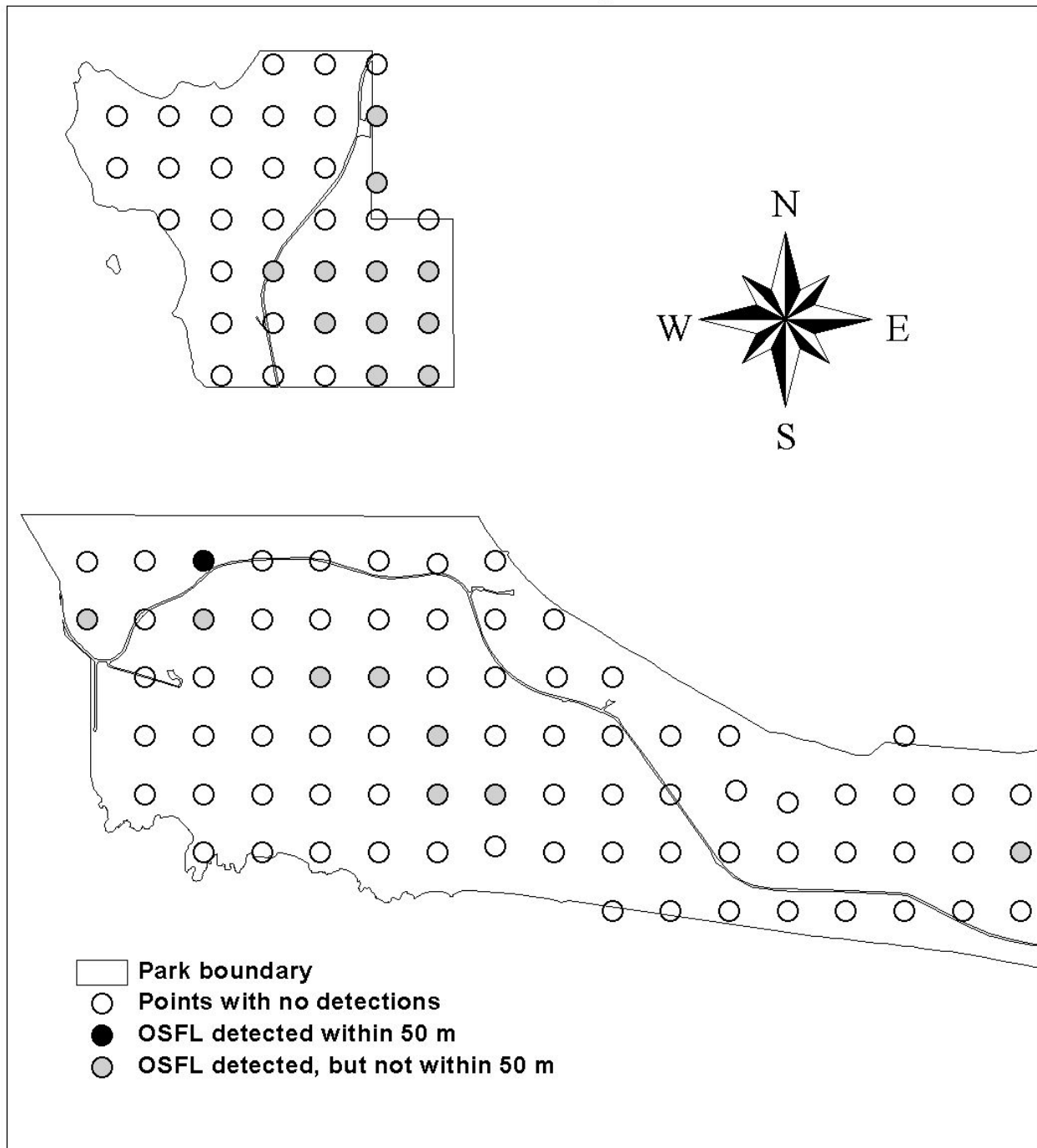
Figure 22. Olive-sided Flycatcher point count detections.

Willow Flycatcher

Park boundary
○ Points with no detections
● WIFL detected within 50 m
◉ WIFL detected, but not within 50 m
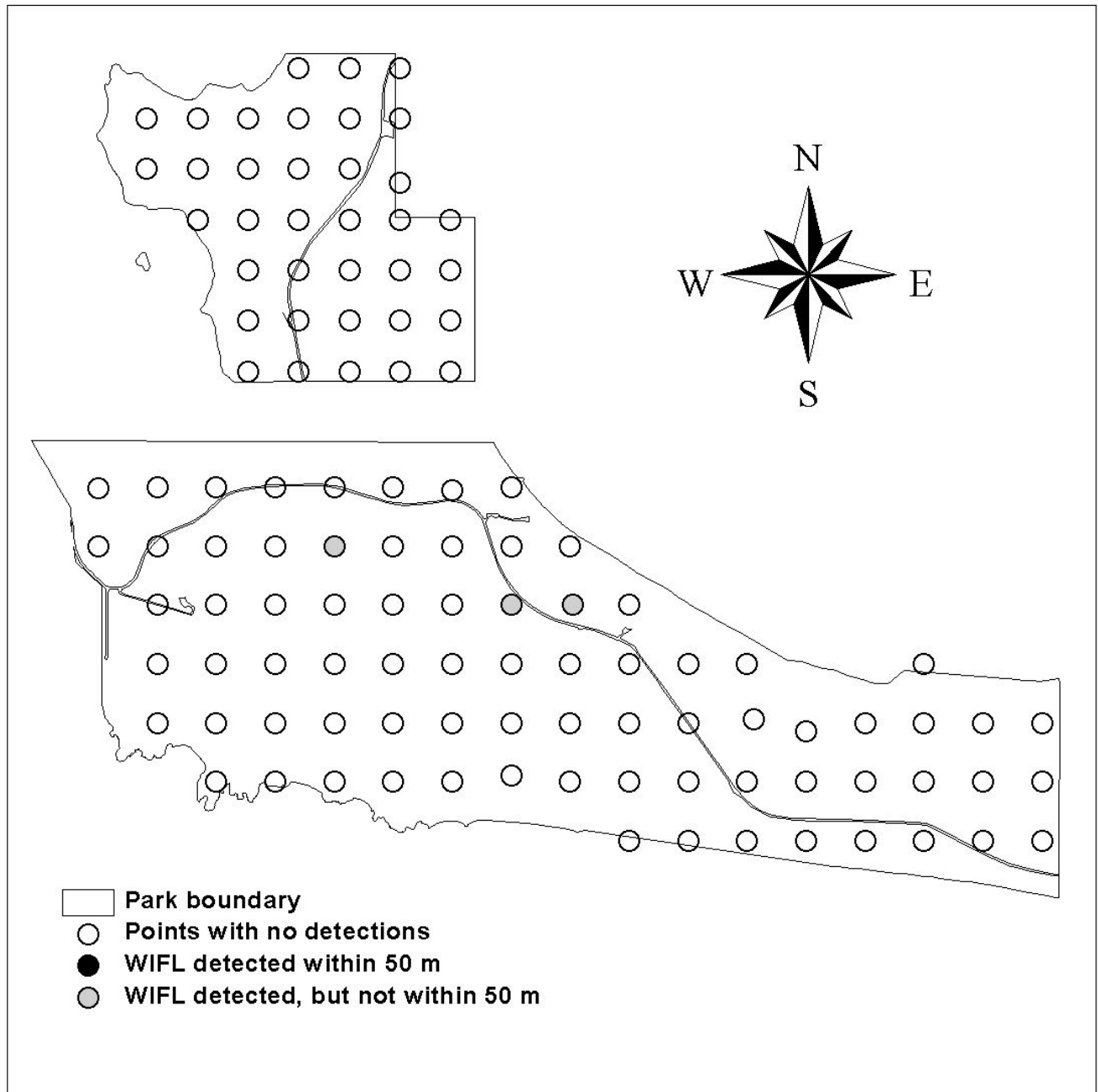
Figure 23. Willow Flycatcher point count detections.

Pacific-slope Flycatcher
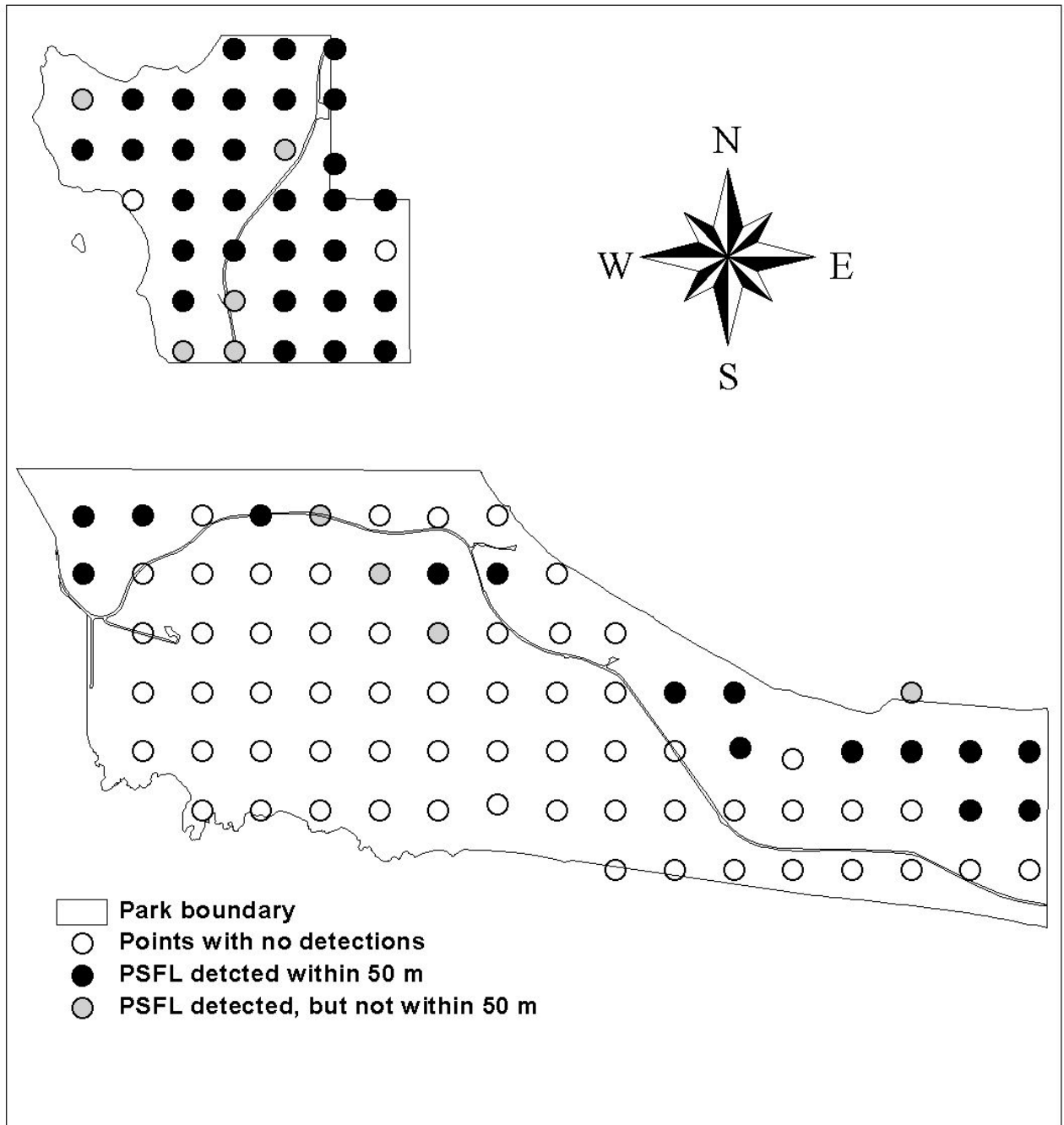
Figure 24. Pacific-slope Flycatcher point count detections.

Cassin's Vireo
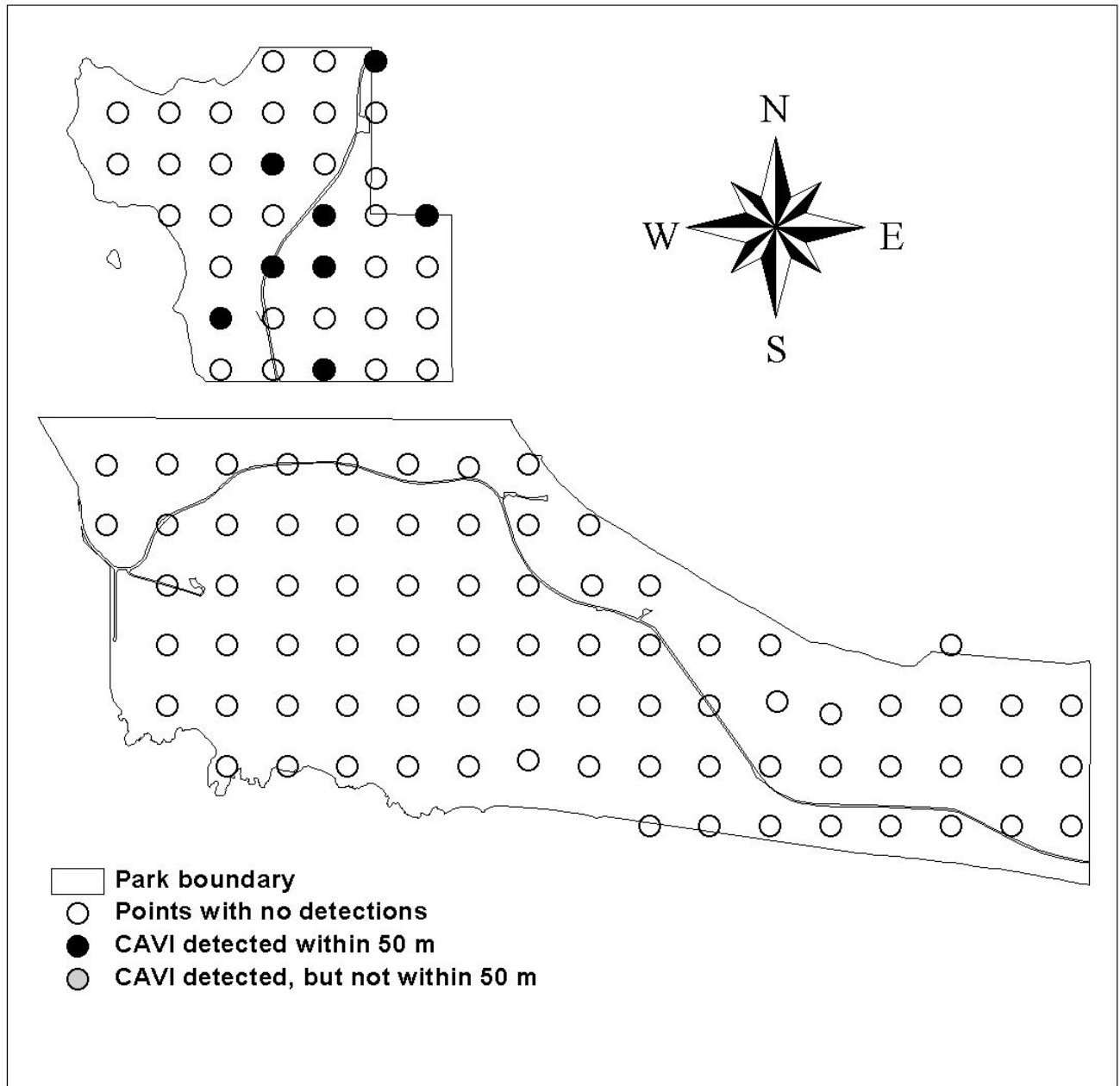
Figure 25. Cassin's Vireo point count detections.

Hutton's Vireo
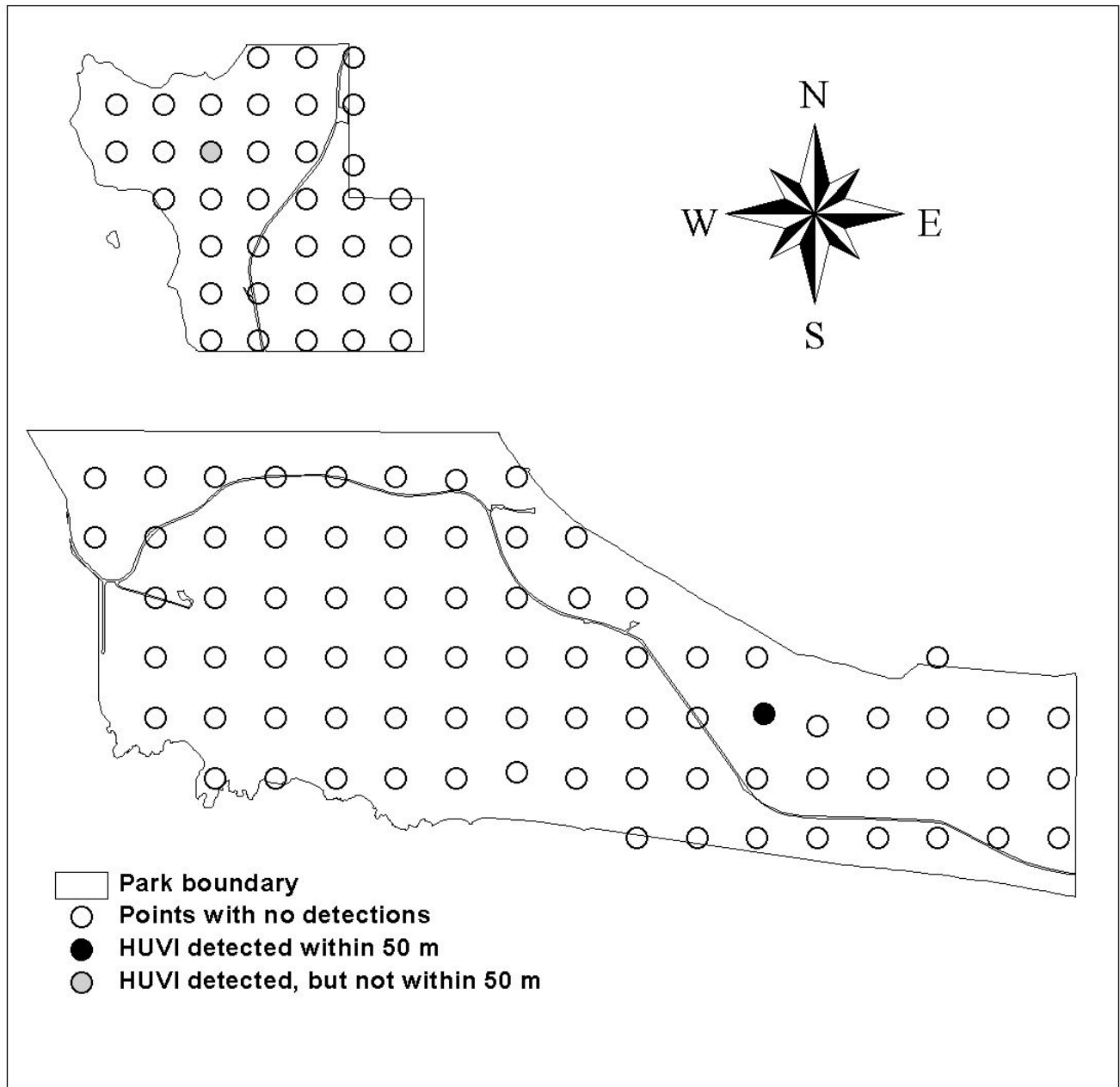
Figure 26. Hutton's Vireo point count detections.

Warbling Vireo
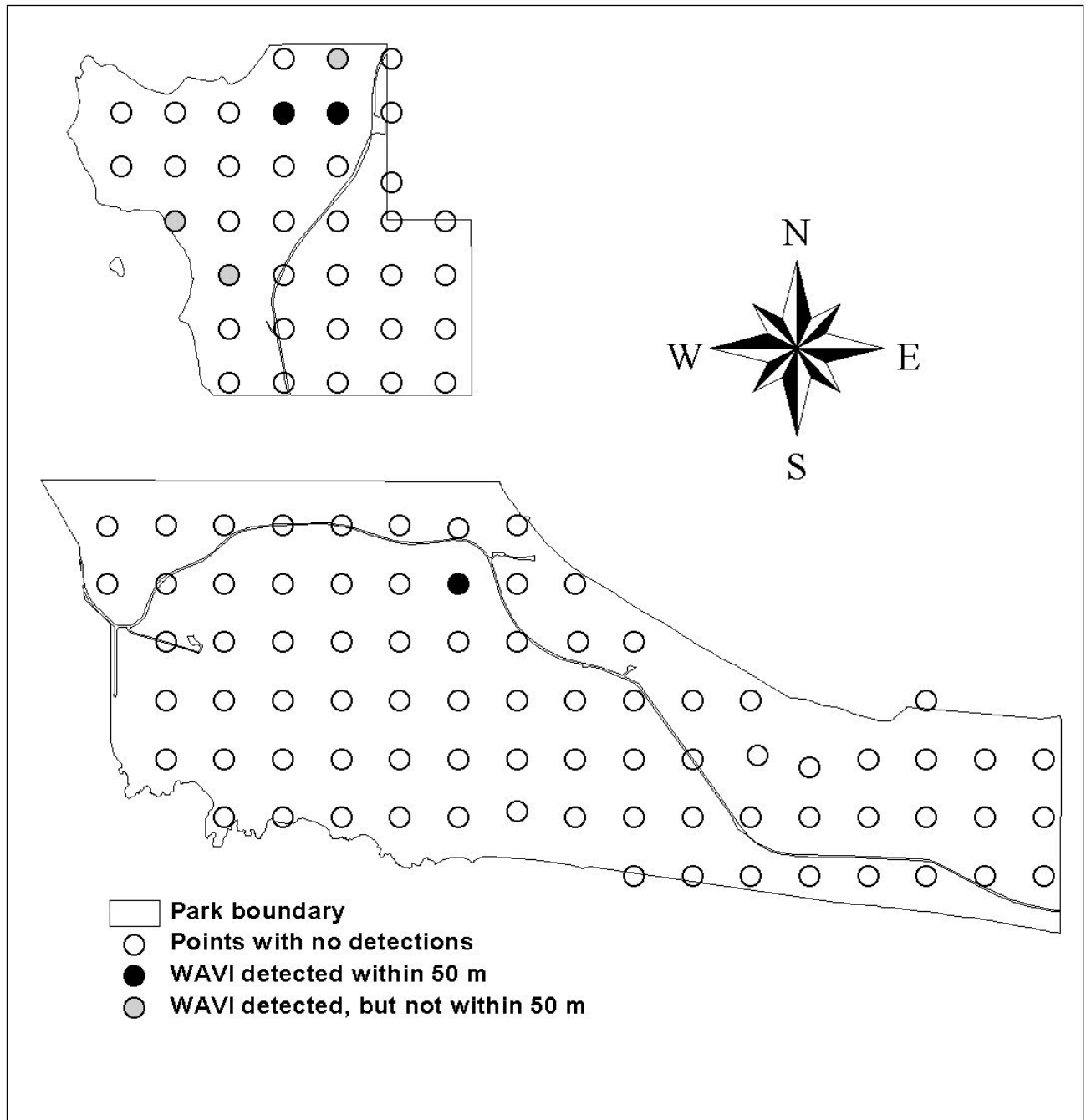
Figure 27. Warbling Vireo point count detections.

American Crow
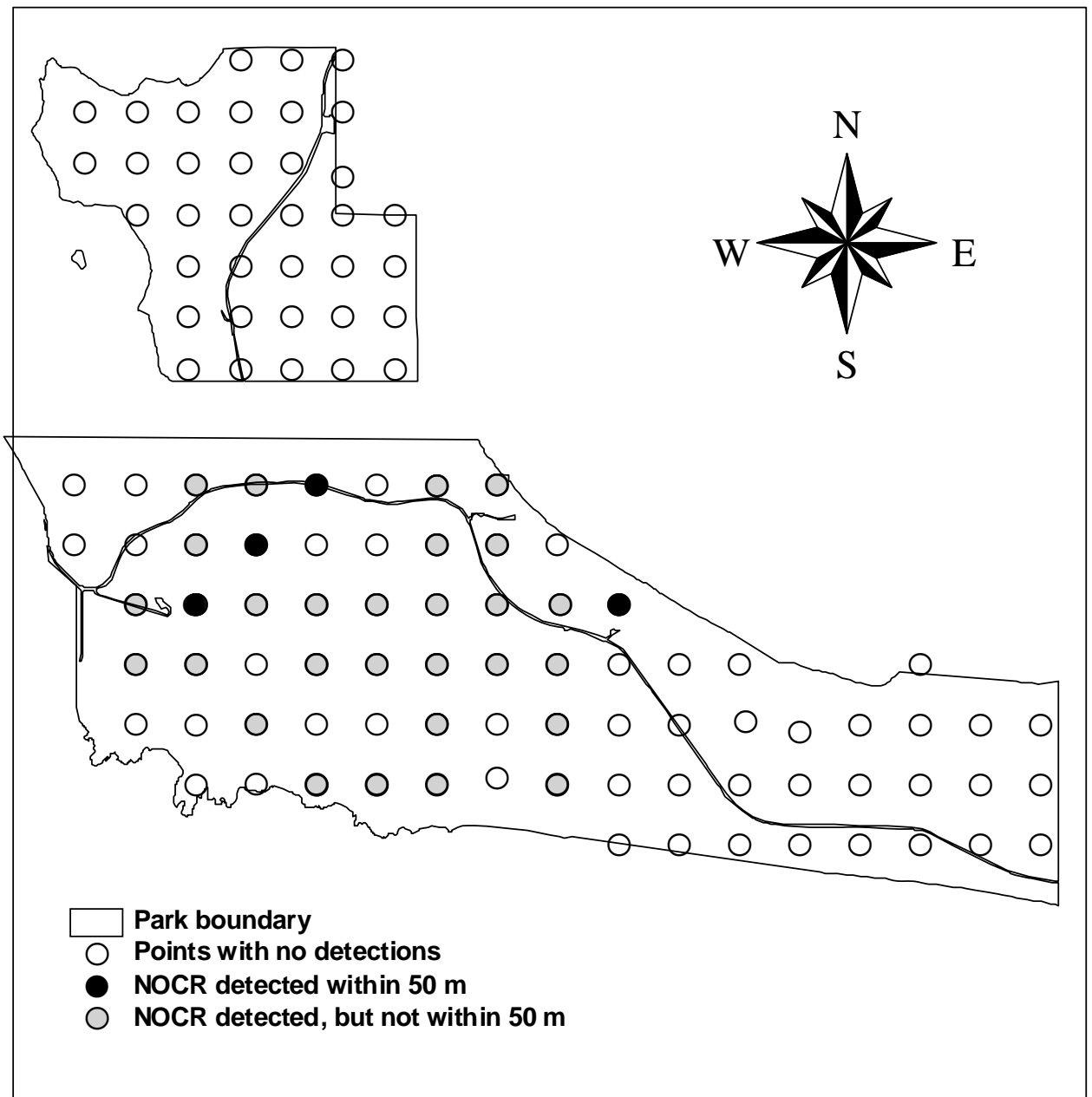
Figure 28. American Crow point count detections.

Common Raven
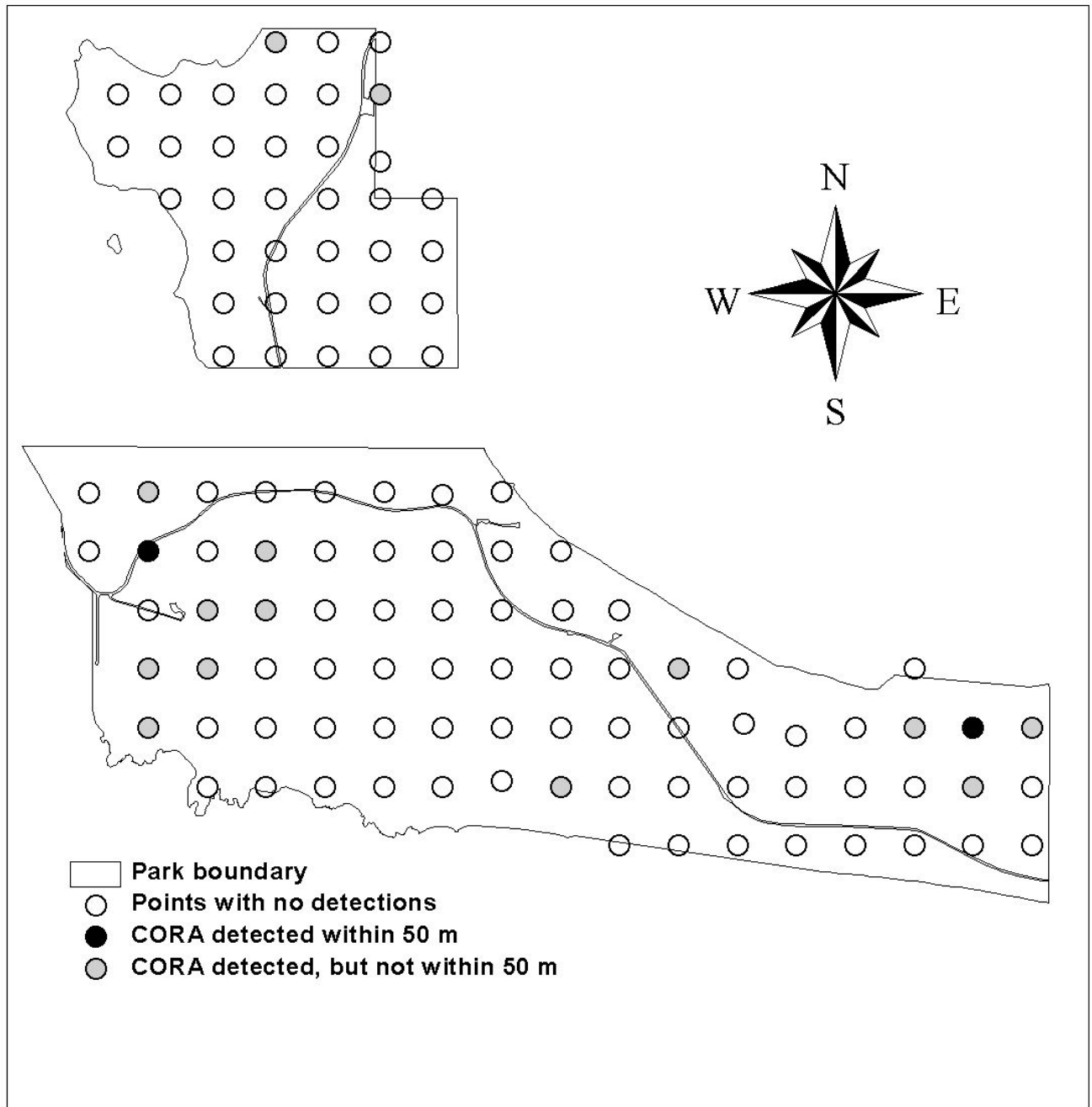
Figure 29. Common Raven point count detections.

Tree Swallow
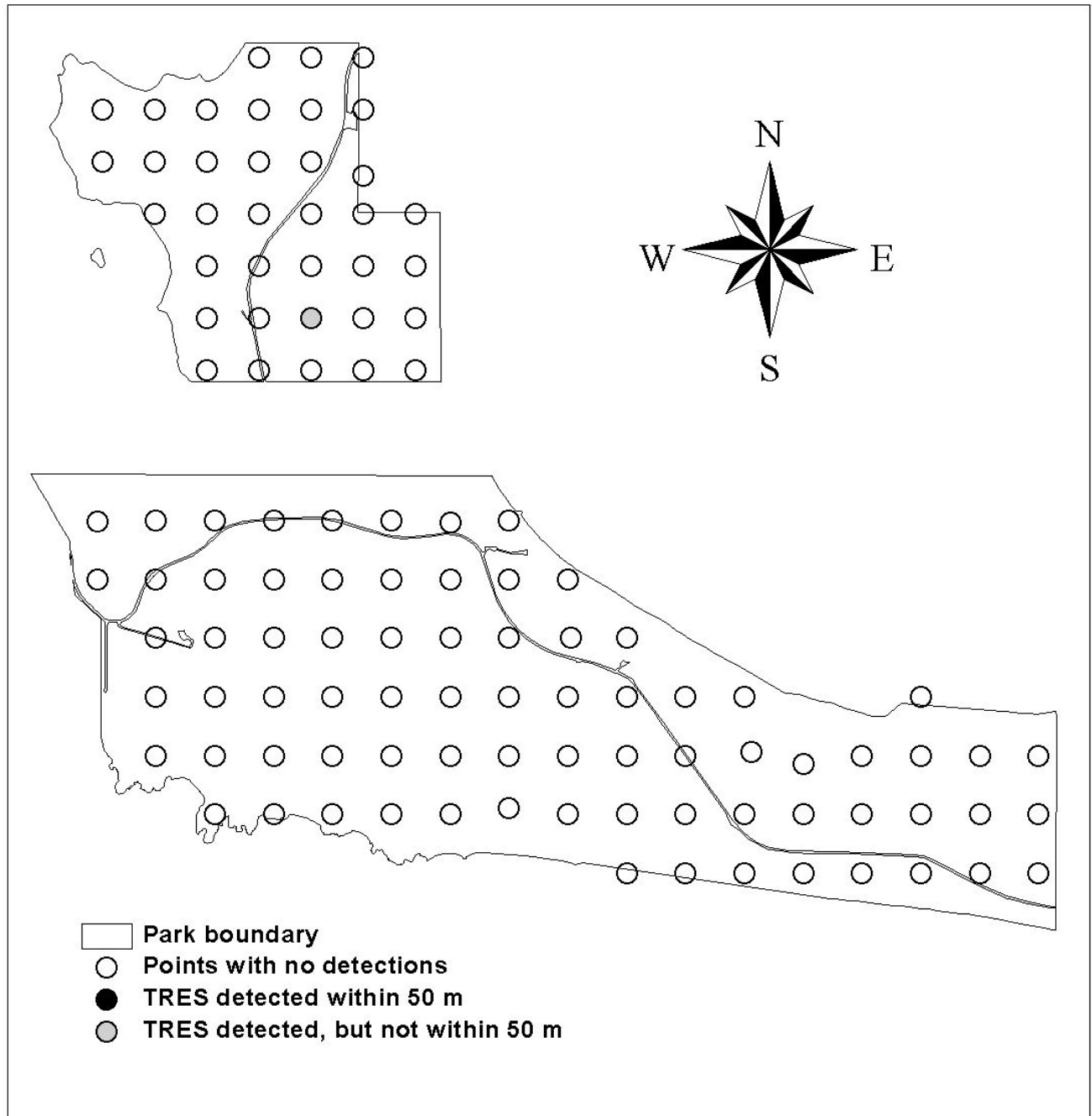
Figure 30. Tree Swallow point count detections.

Violet-green Swallow
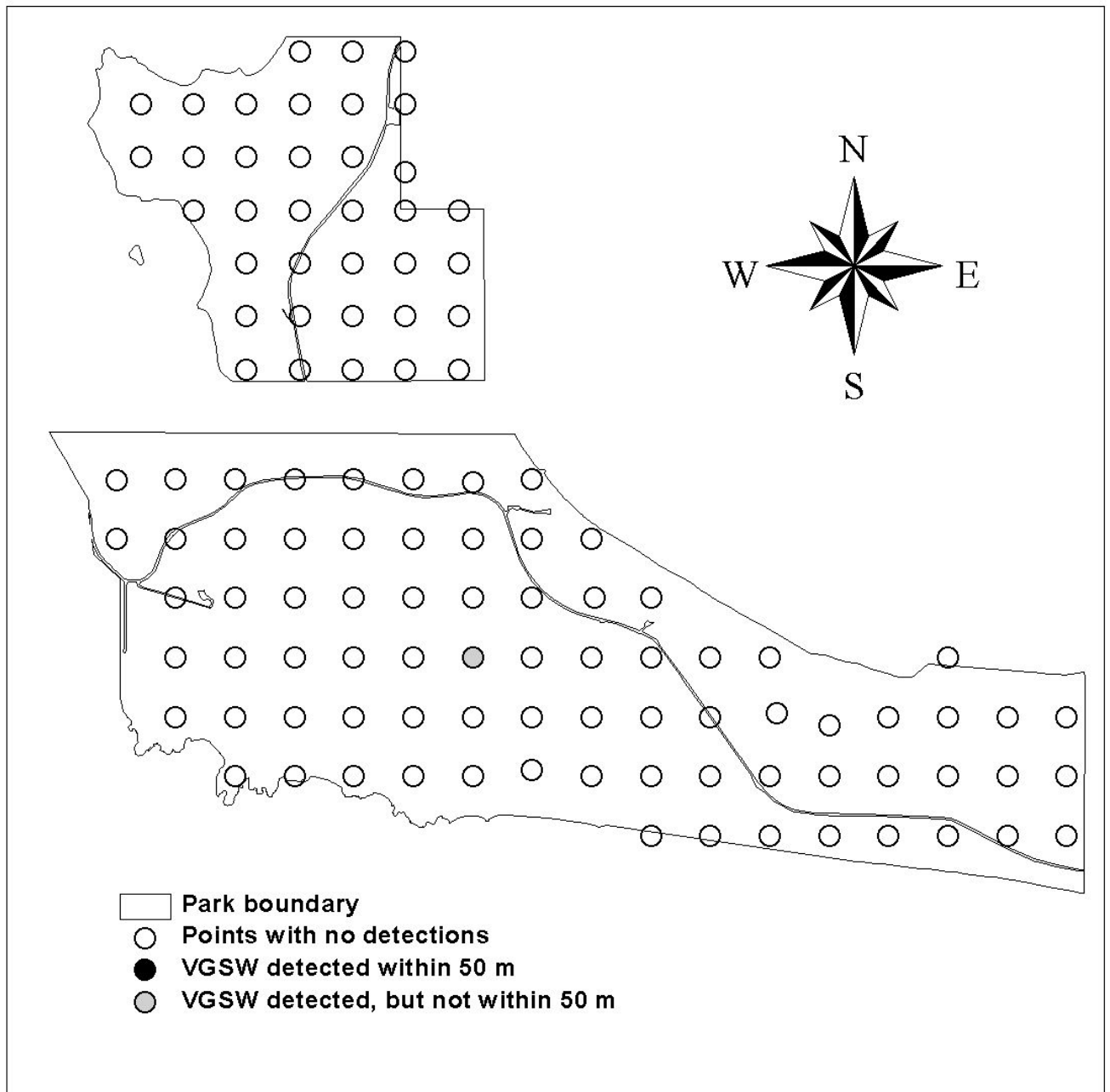
Figure 31. Violet-green Swallow point count detections.

Northern Rough-winged Swallow
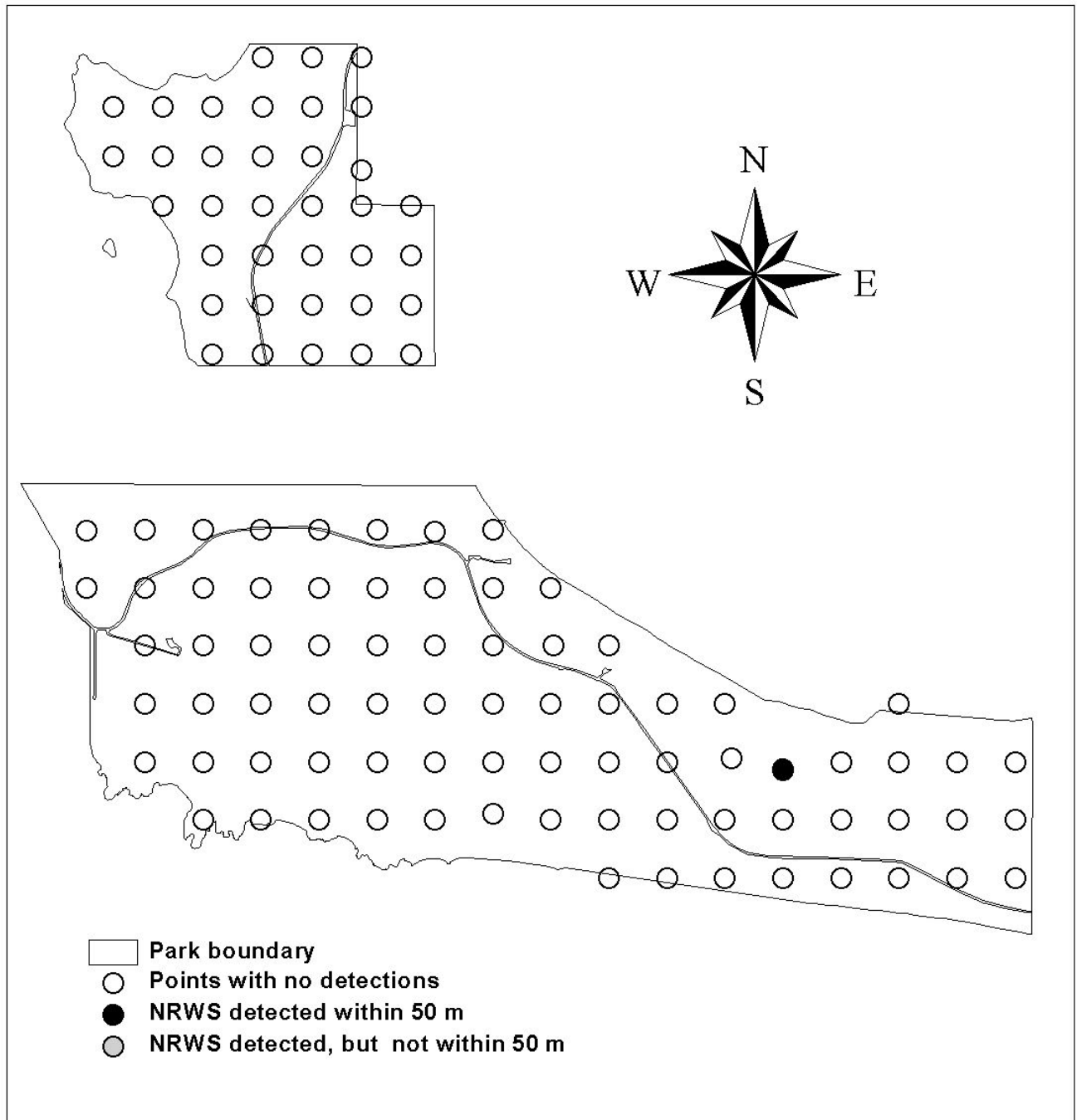
Figure 32. Northern Rough-winged Swallow point count detections.

Cliff Swallow
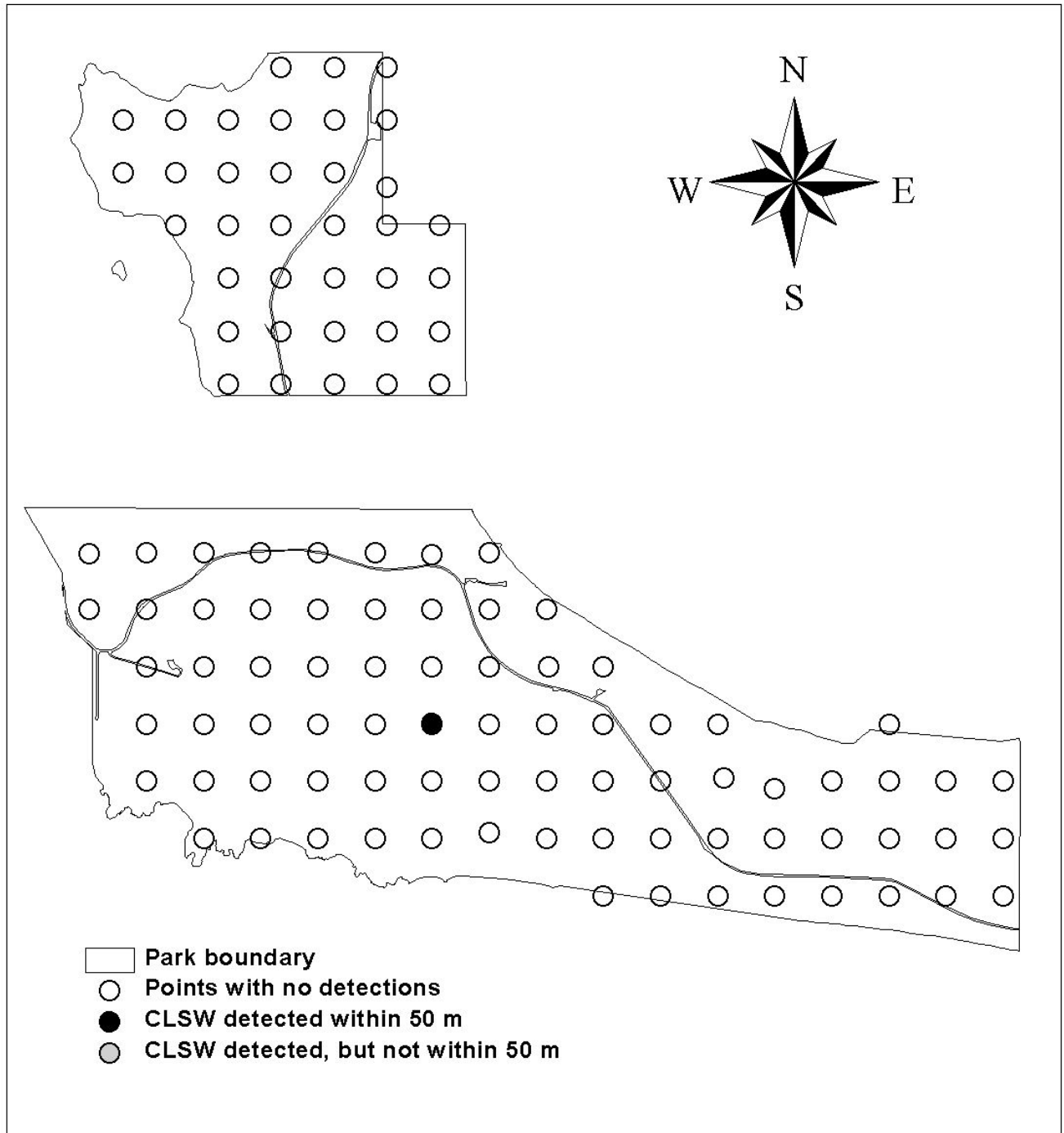
Figure 33. Cliff Swallow point count detections.

Barn Swallow
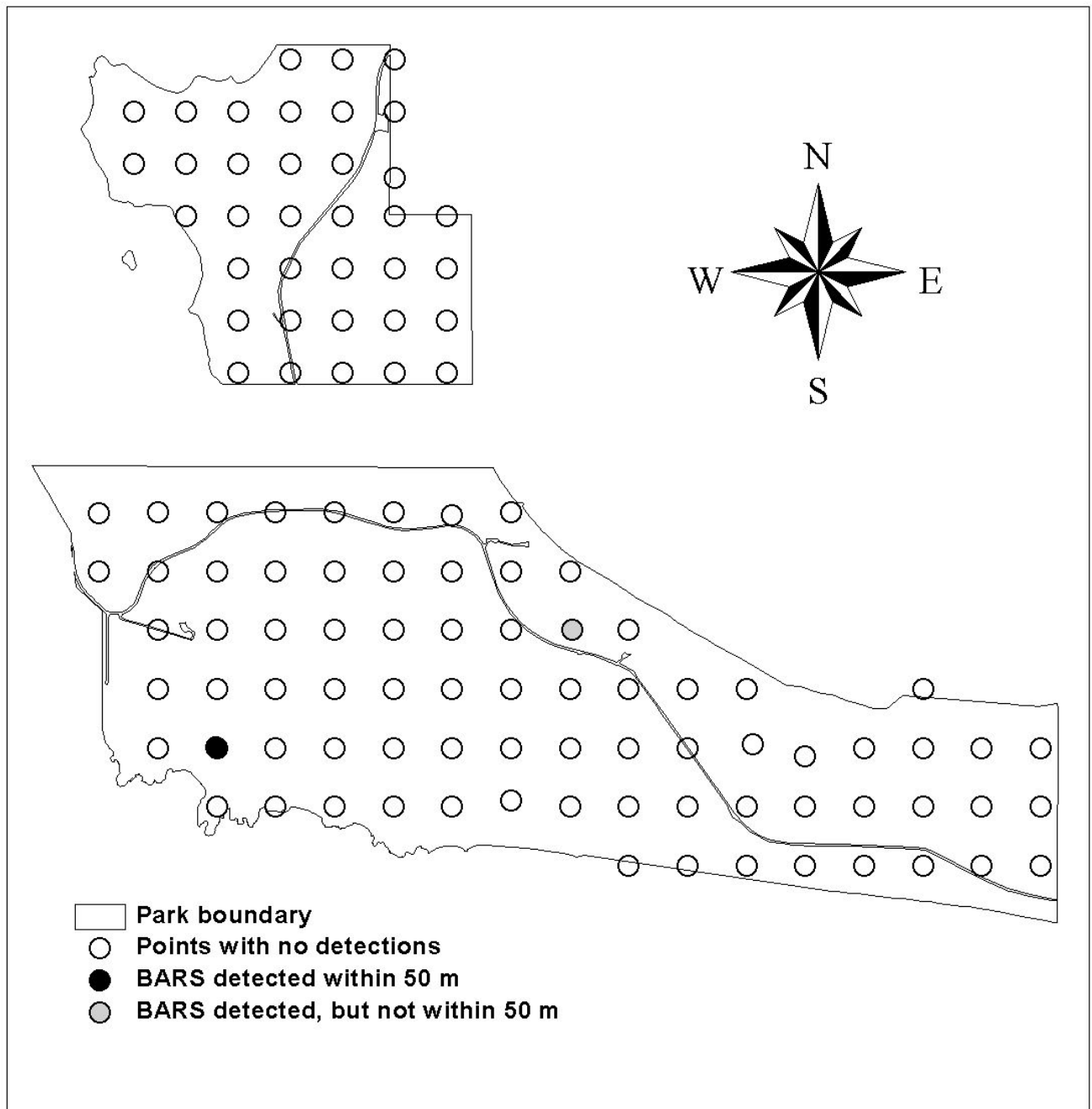
Figure 34. Barn Swallow point count detections.

Chestnut-backed Chickadee
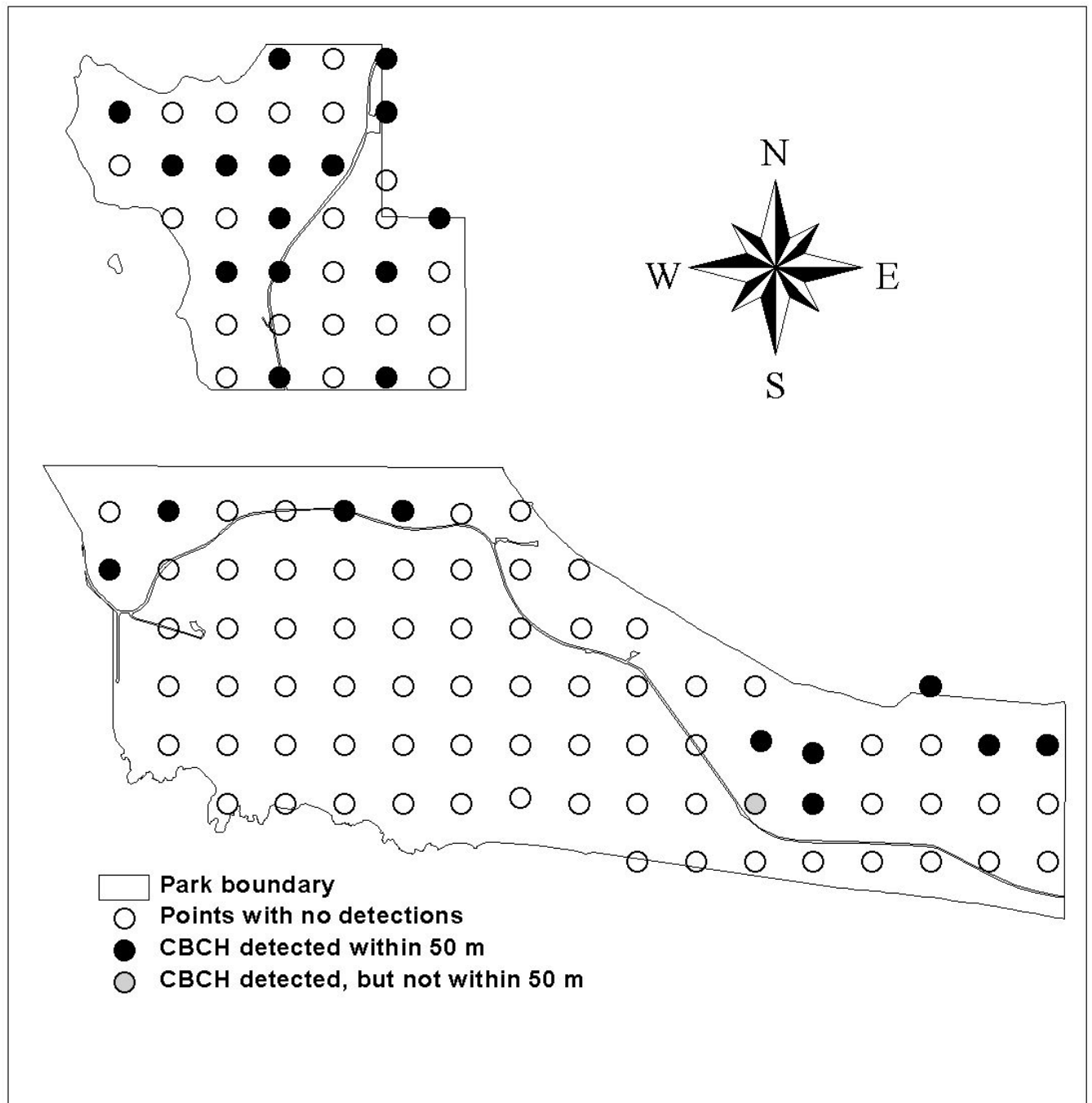
Figure 35. Chestnut-backed Chickadee point count detections.

Bushtit
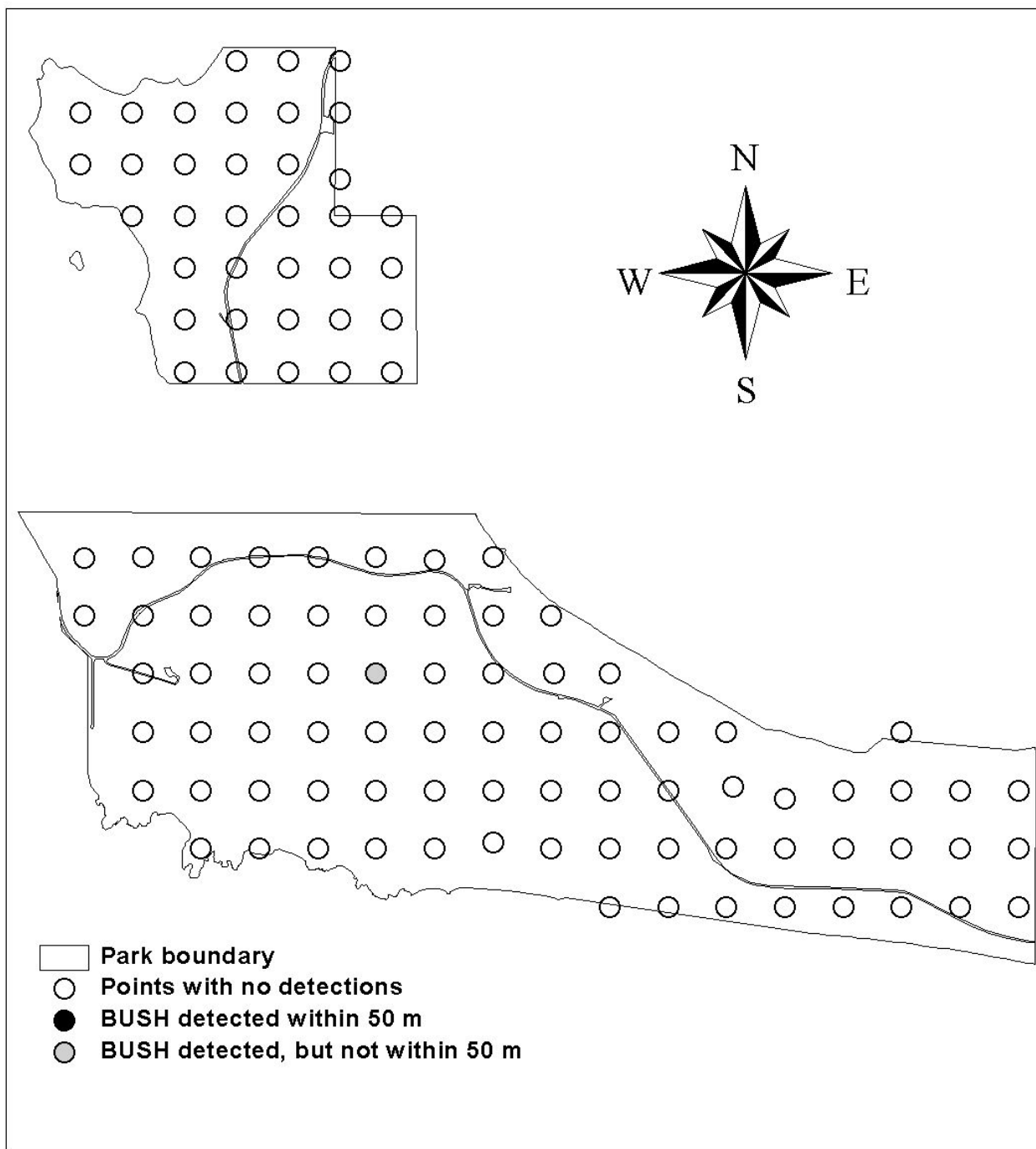
Figure 36. Bushtit point count detections.

Red-breasted Nuthatch
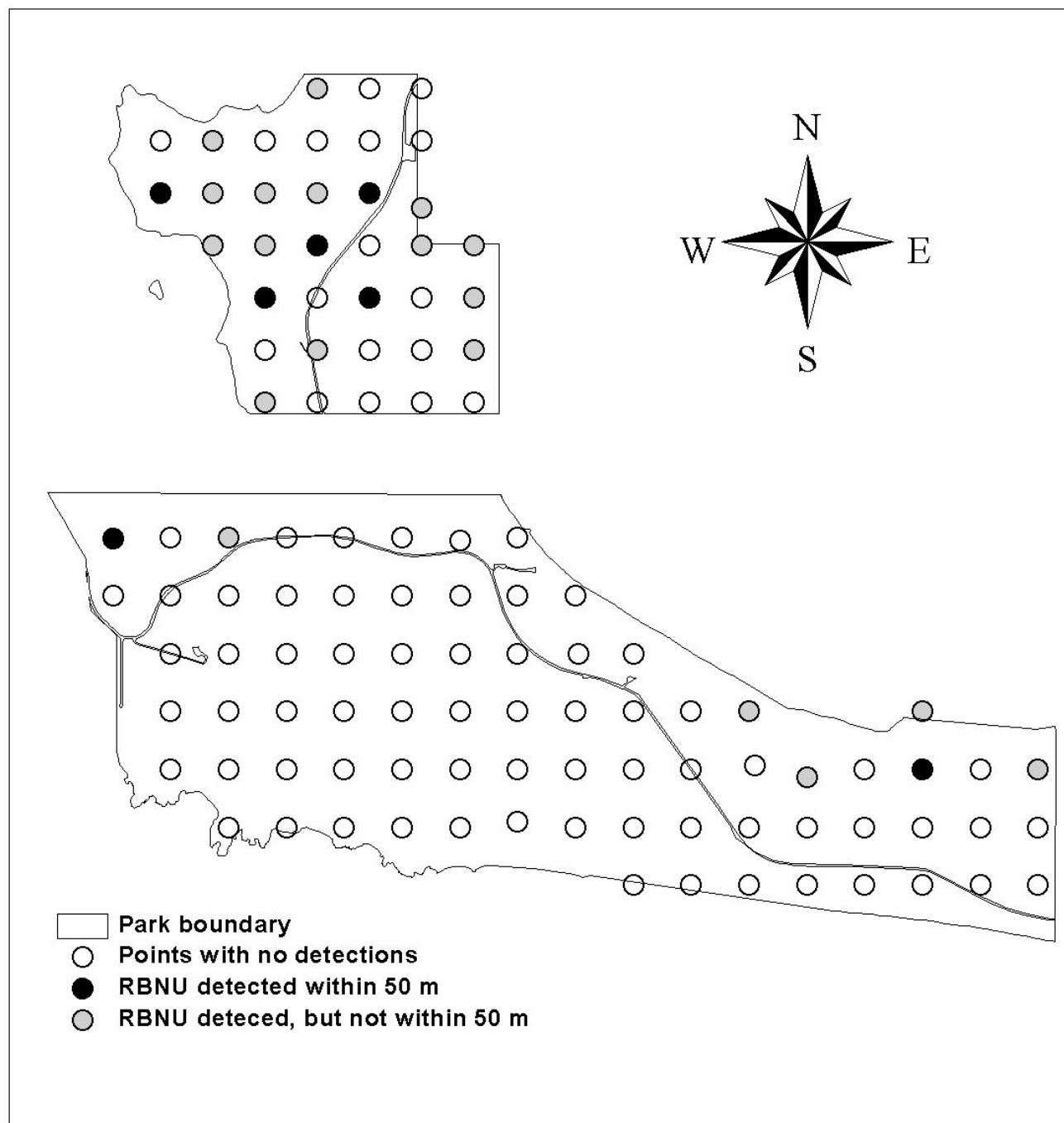
Figure 37. Red-breasted Nuthatch point count detections.

Brown Creeper
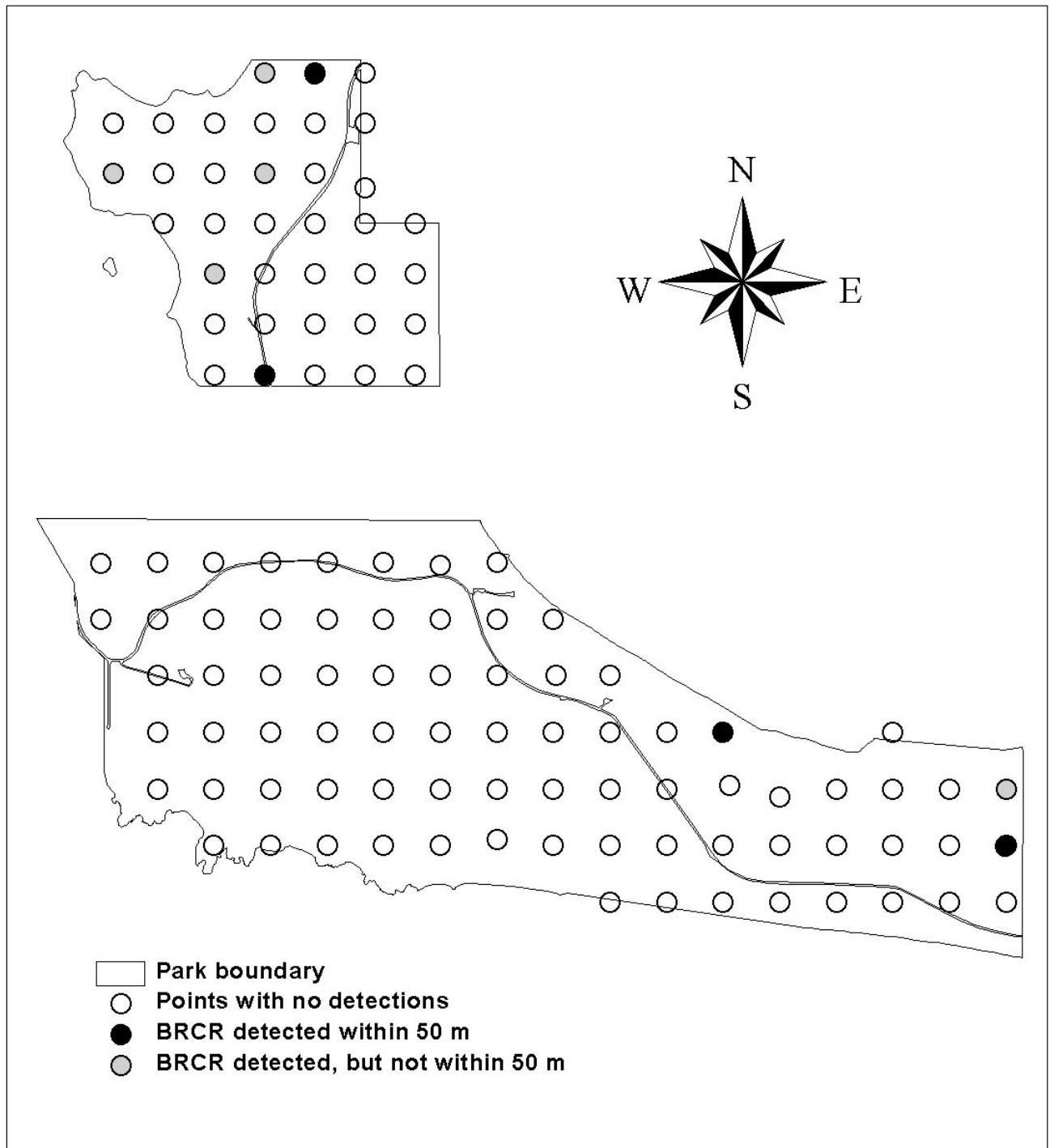
Figure 38. Brown Creeper point count detections.

Bewick's Wren
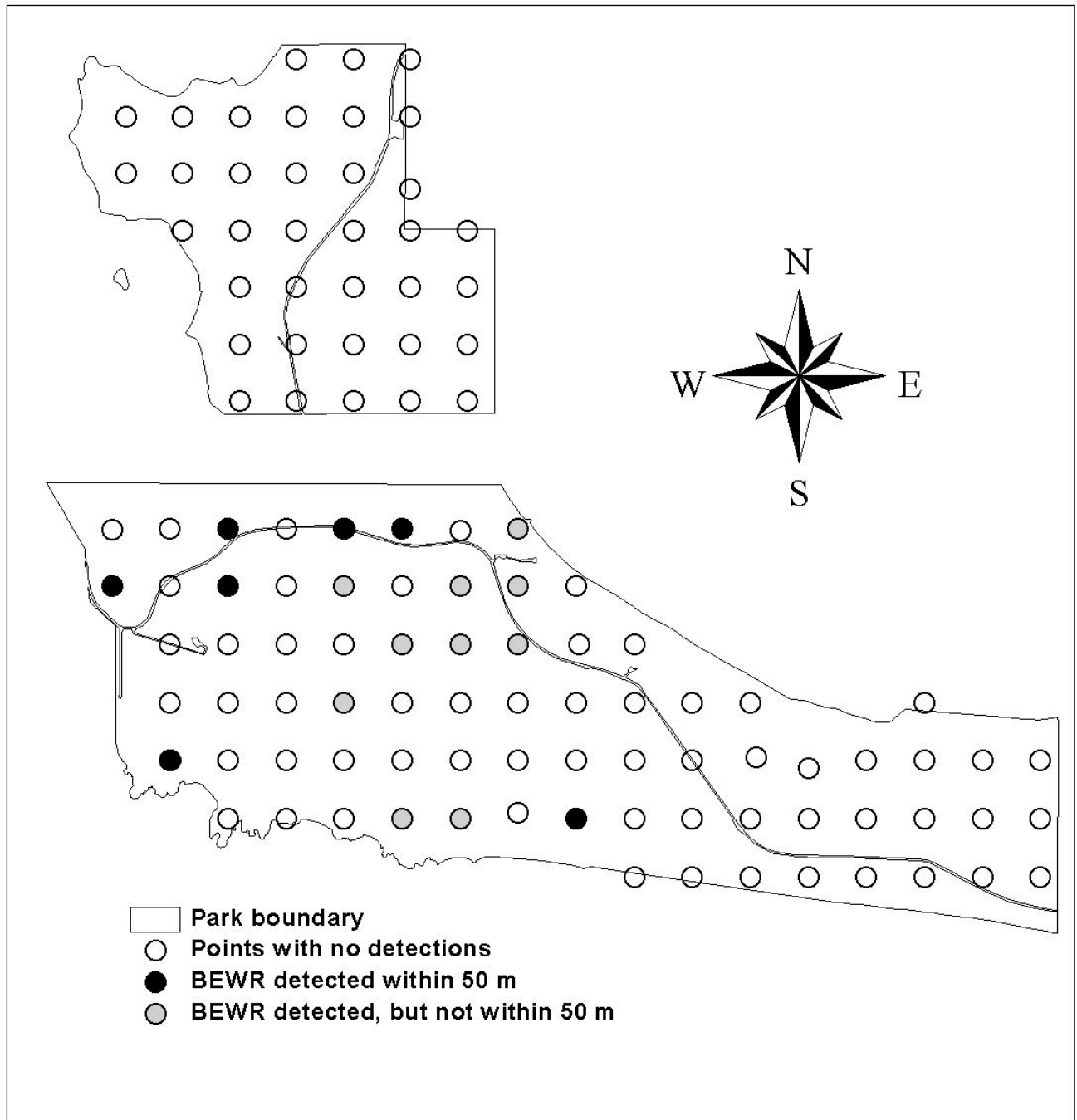
Figure 39. Bewick's Wren point count detections.

House Wren
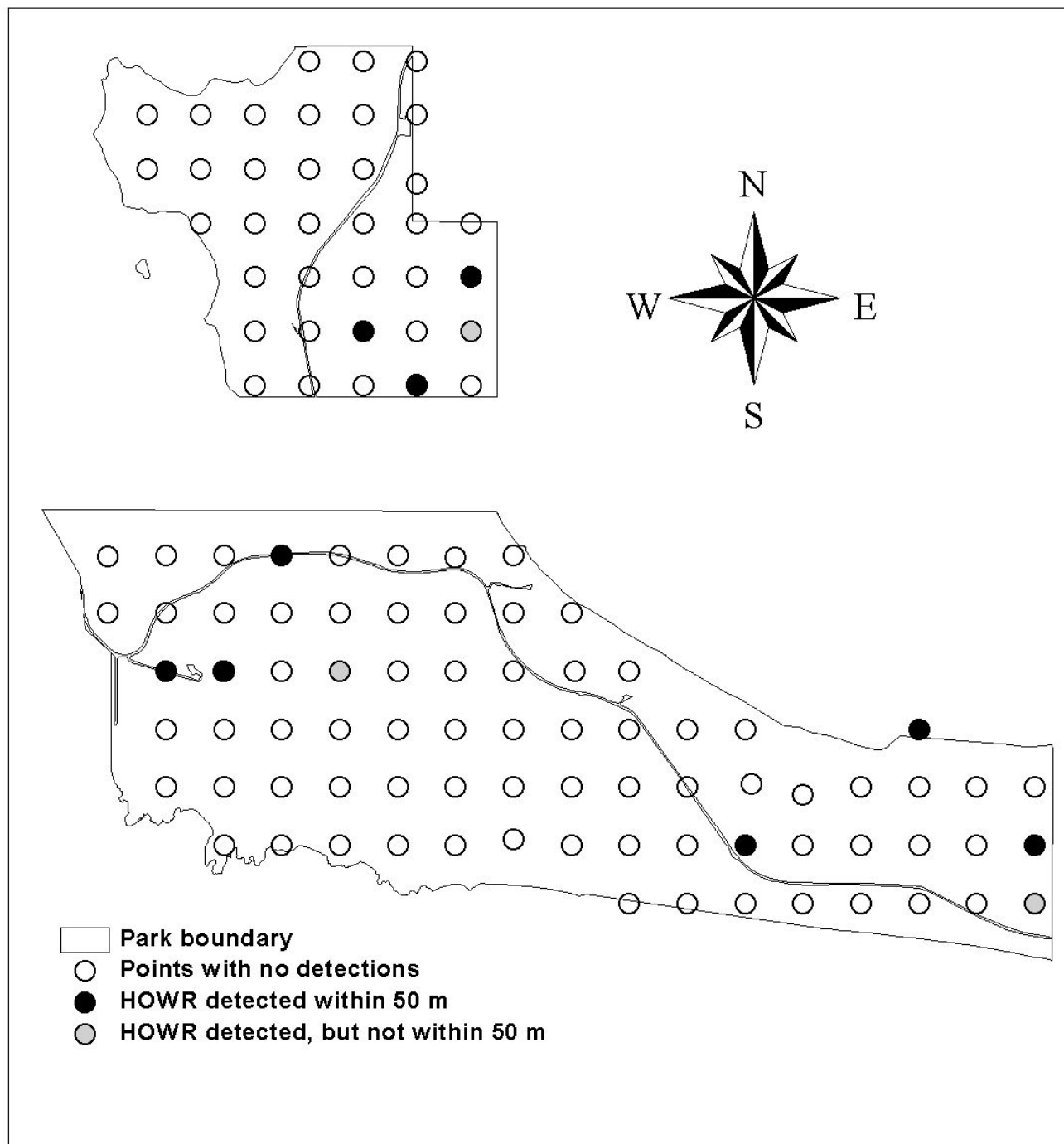
Figure 40. House Wren point count detections.

Winter Wren
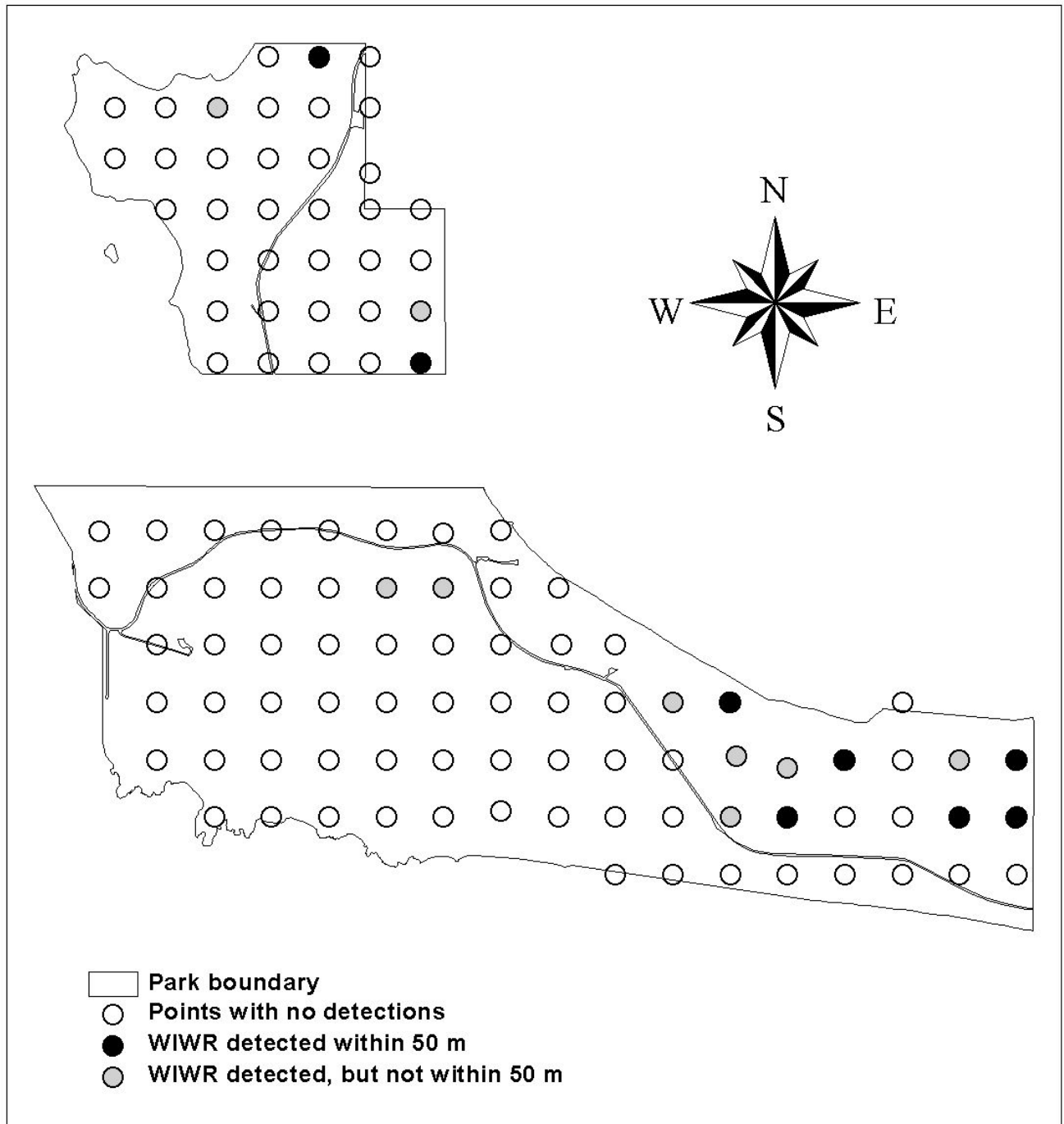
Figure 41. Winter Wren point count detections.

Marsh Wren
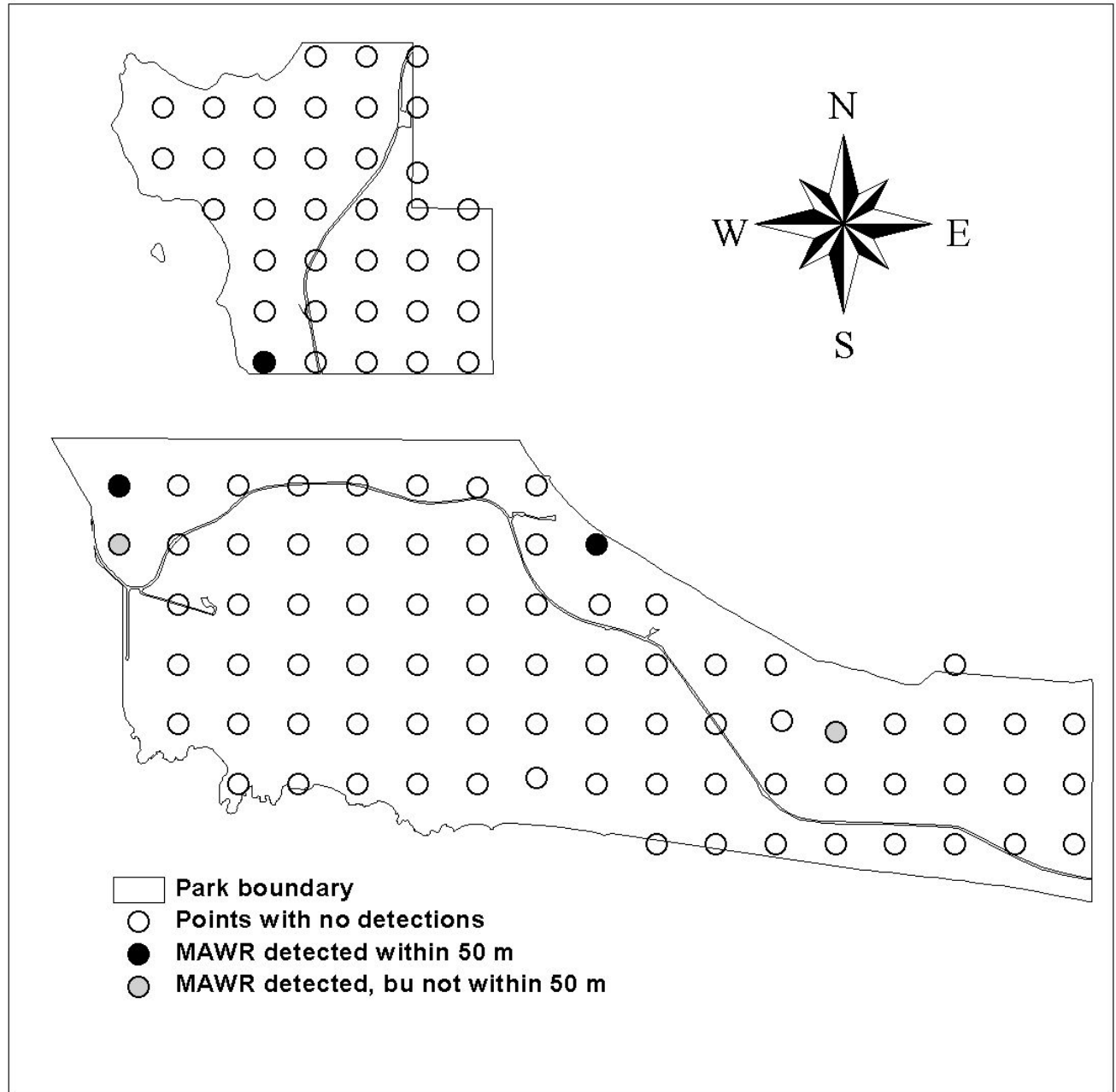
Figure 42. Marsh Wren point count detections.

Golden-crowned Kinglet
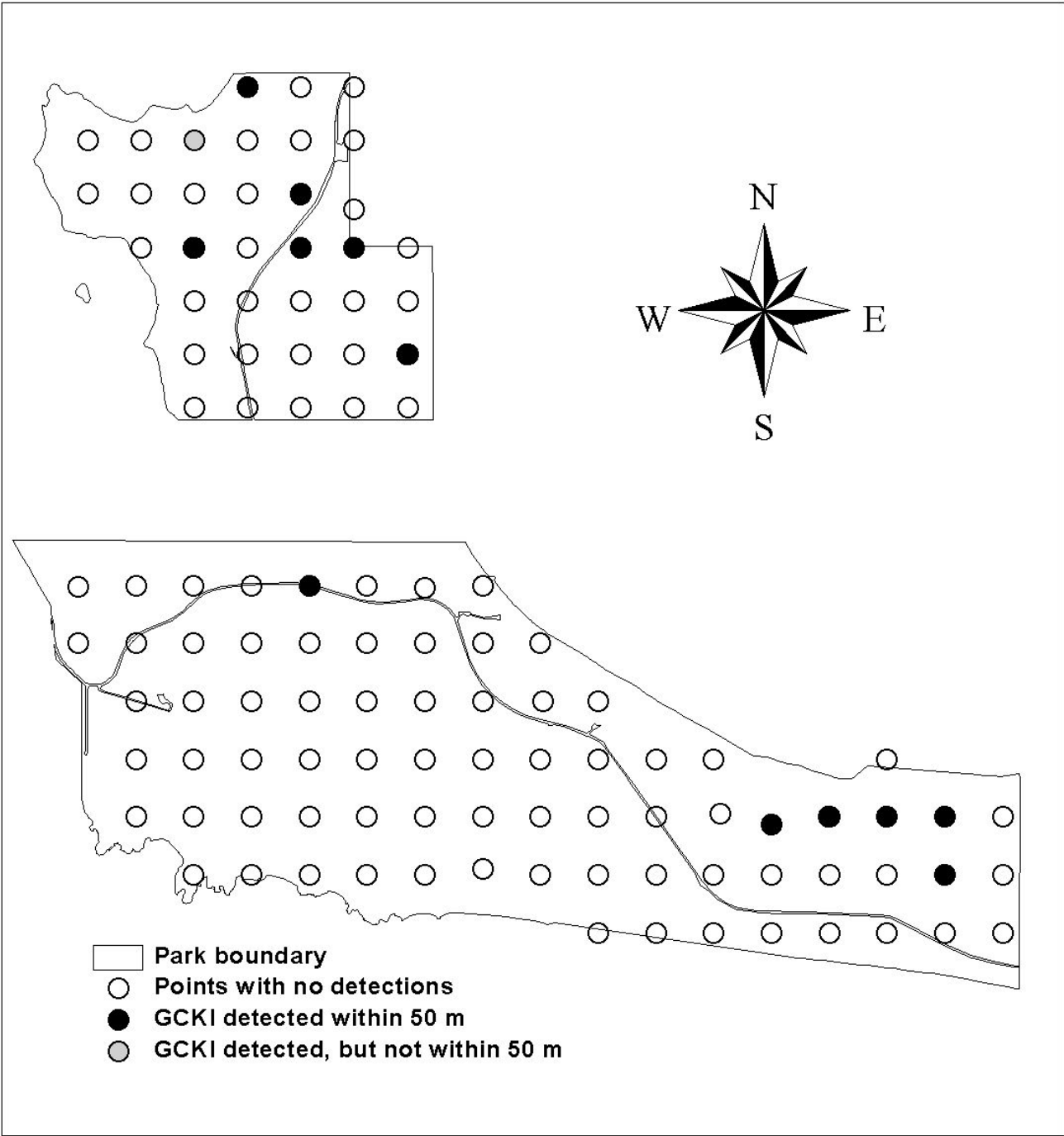
Figure 43. Golden-crowned Kinglet point count detections.

American Robin
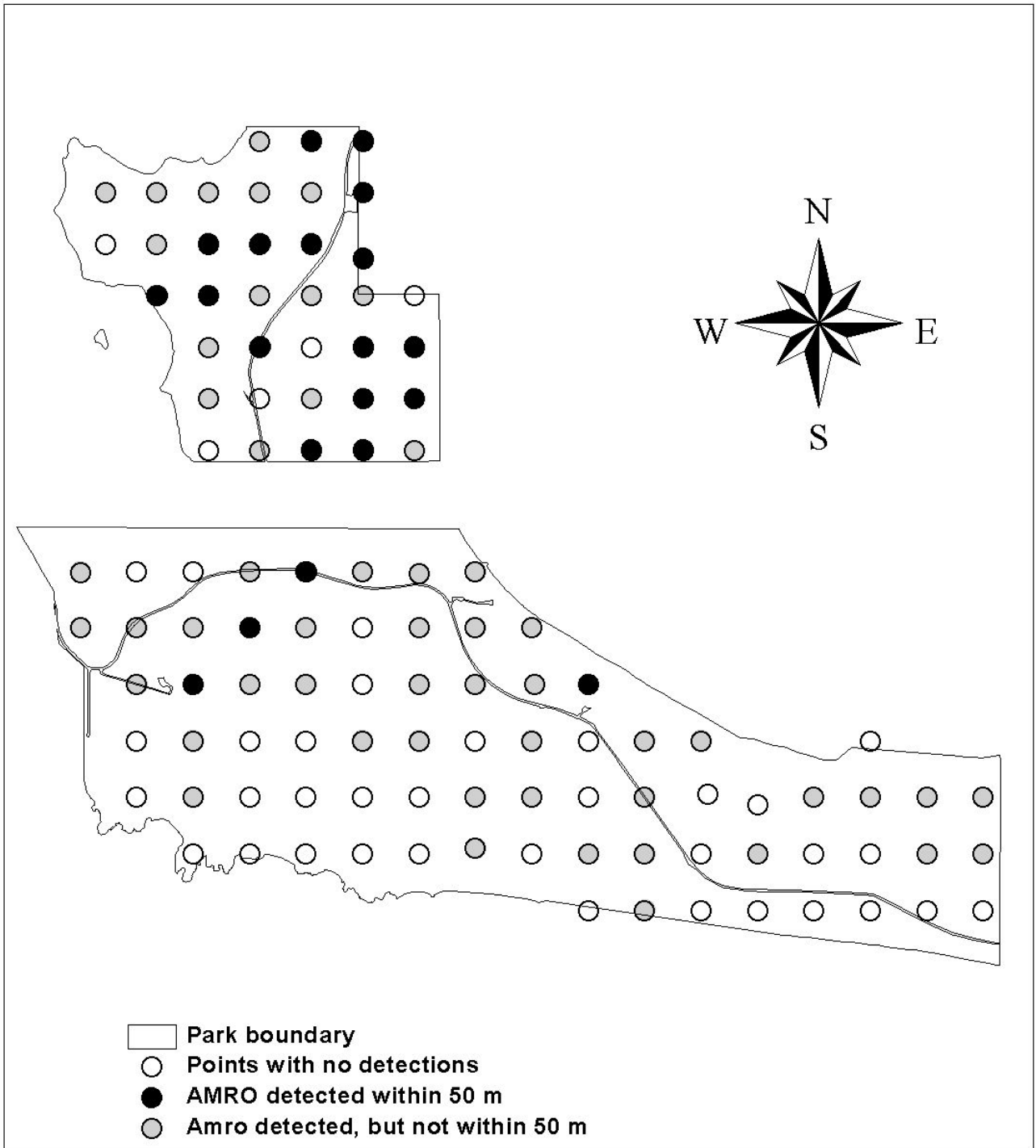
Figure 44. American Robin point count detections.

Swainson's Thrush
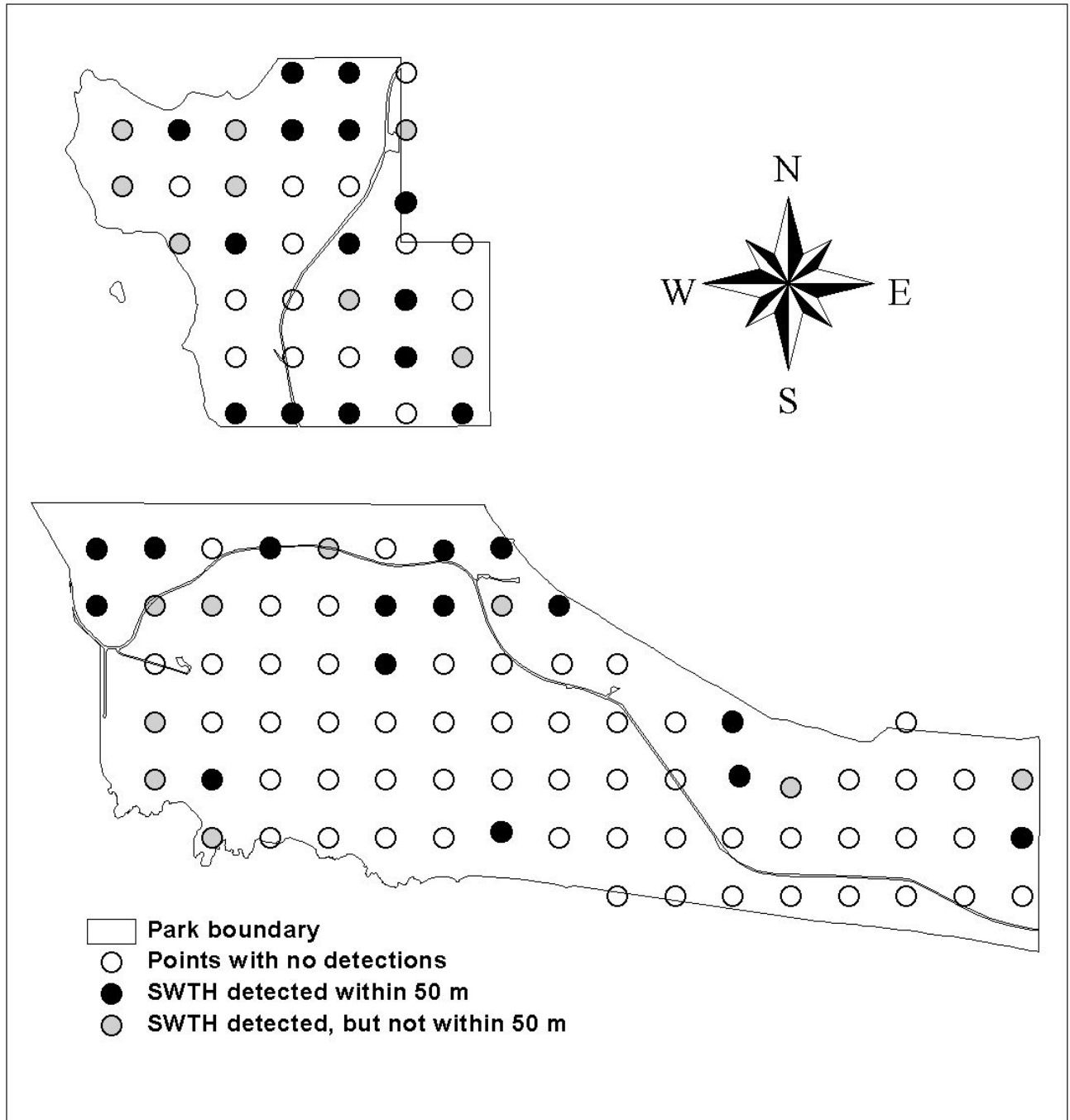
Figure 45. Swainson's Thrush point count detections.

European Starling

Park boundary
○ Points with no detections
● EUST detected within 50 m
◉ EUST detected, but not within 50 m
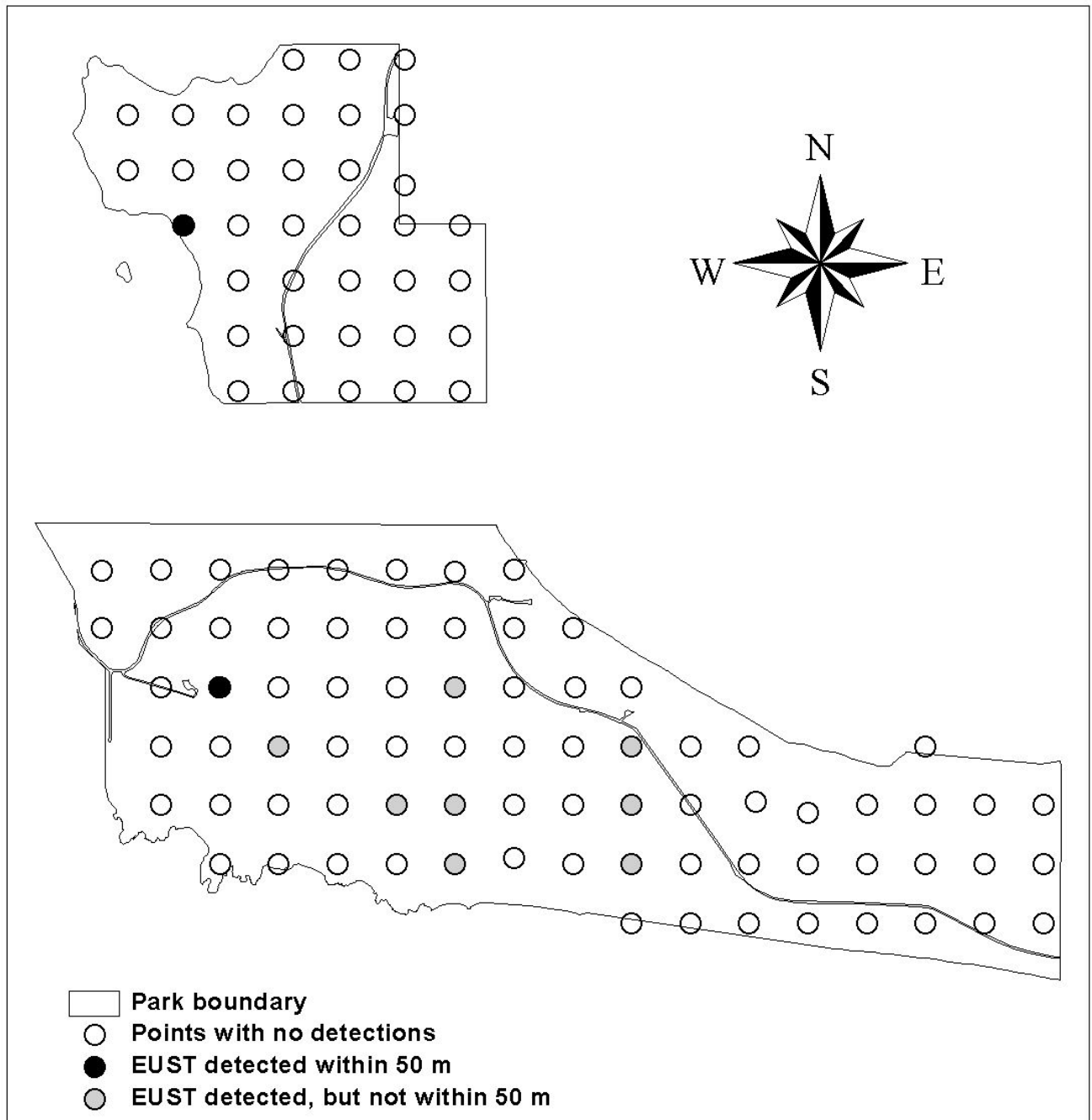
Figure 346. European Starling point count detections.

Orange-crowned Warbler
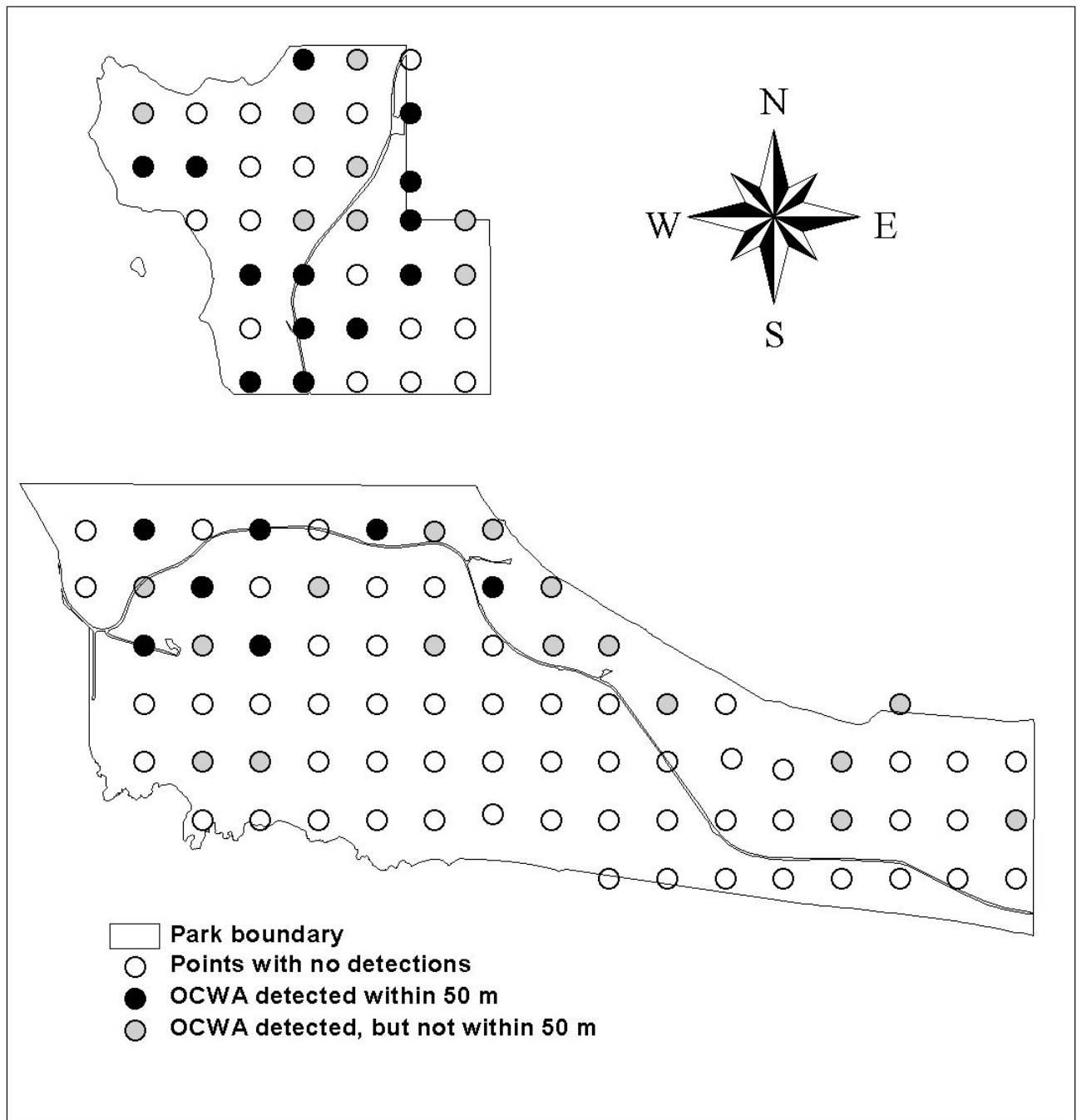
Figure 47. Orange-crowned Warbler point count detections.

Yellow Warbler
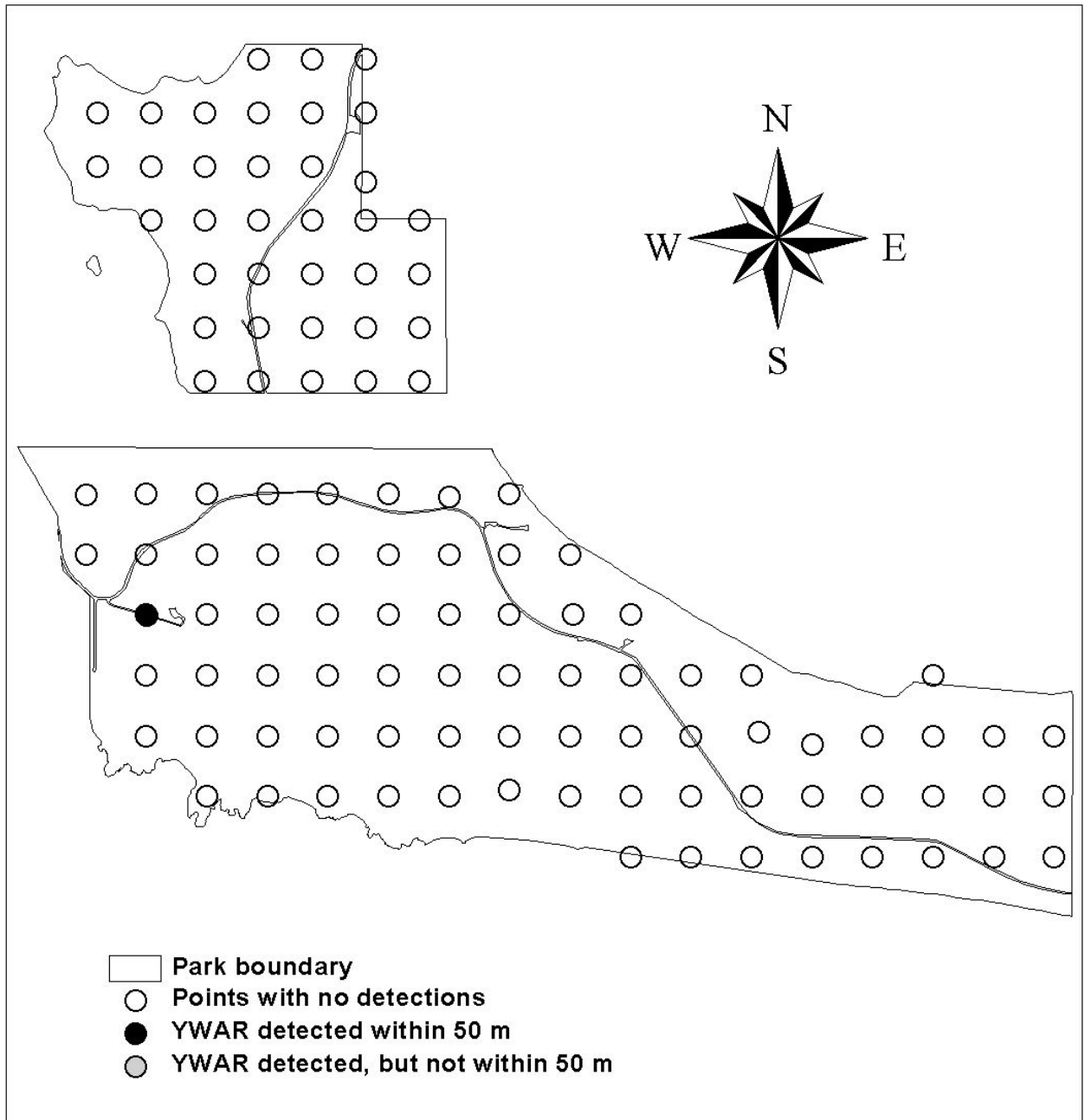
Figure 48. Yellow Warbler point count detections.

Yellow-rumped Warbler
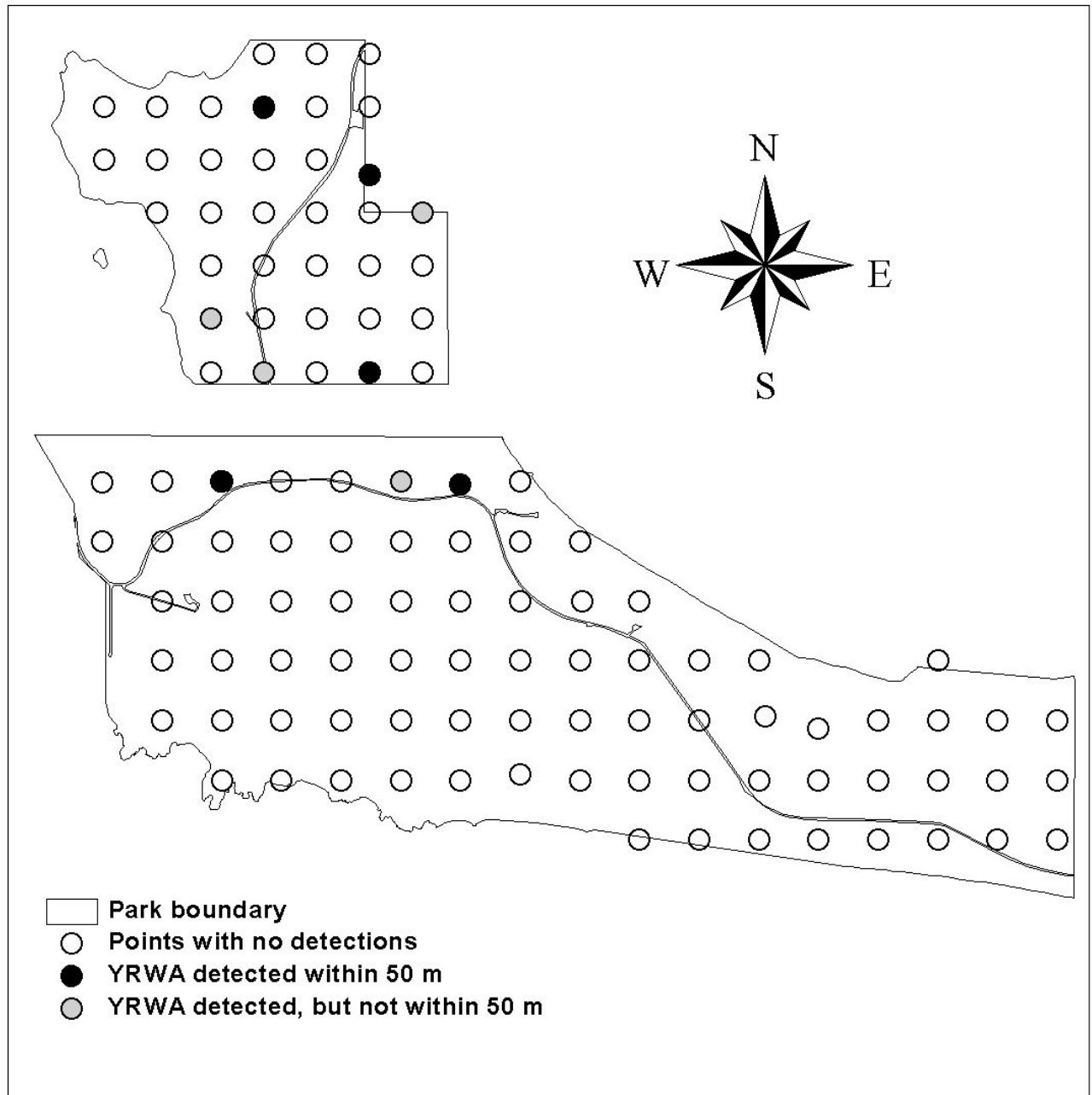
Figure 49. Yellow-rumped Warbler point count detections.

Black-throated Gray Warbler
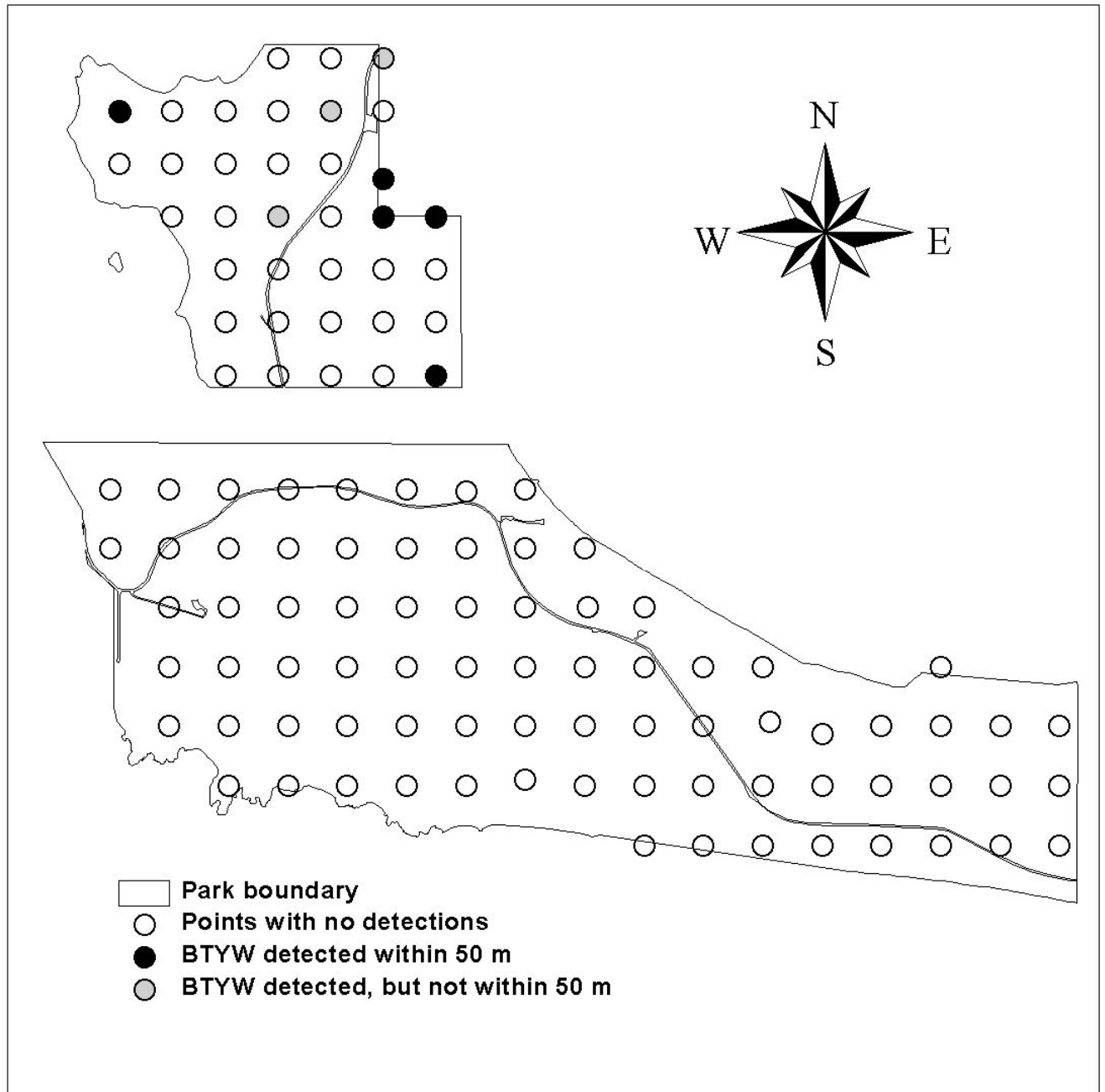
Figure 50. Black-throated Gray Warbler point count detections.

Townsend's Warbler
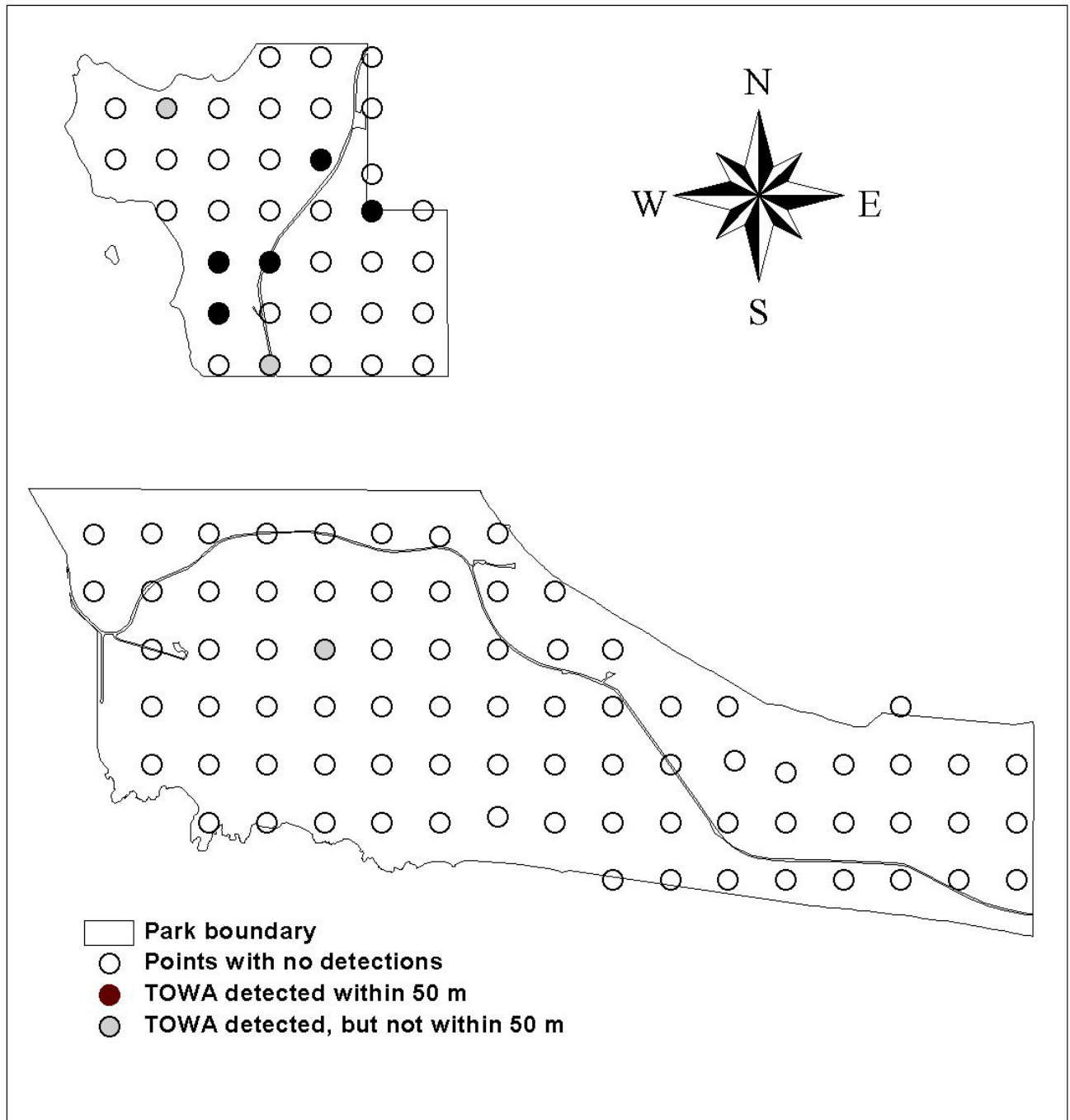
Figure 51. Townsend's Warbler point count detections.

MacGillivray's Warbler
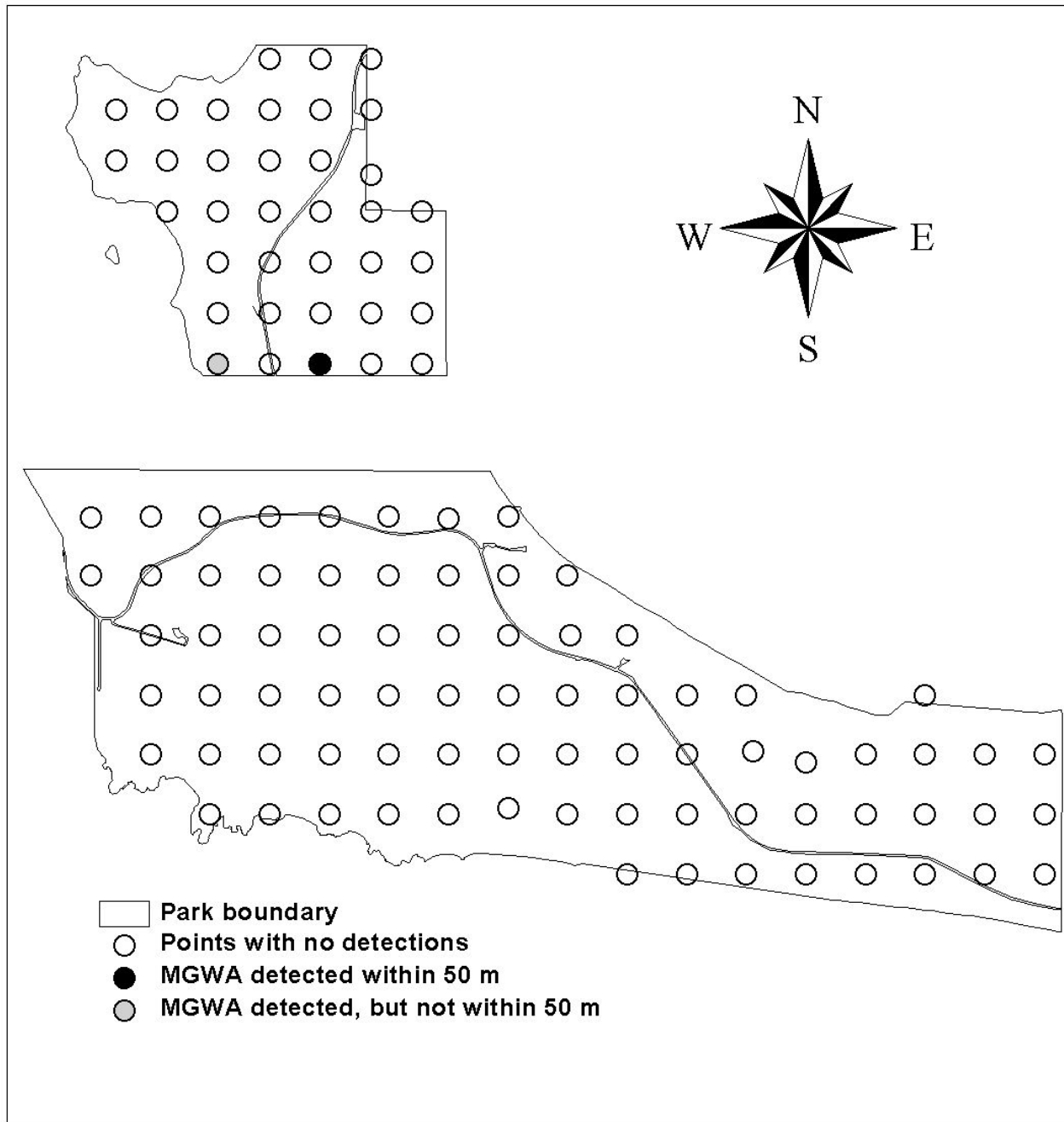
Figure 52. MacGillivray's Warbler point count detections.

Common Yellowthroat
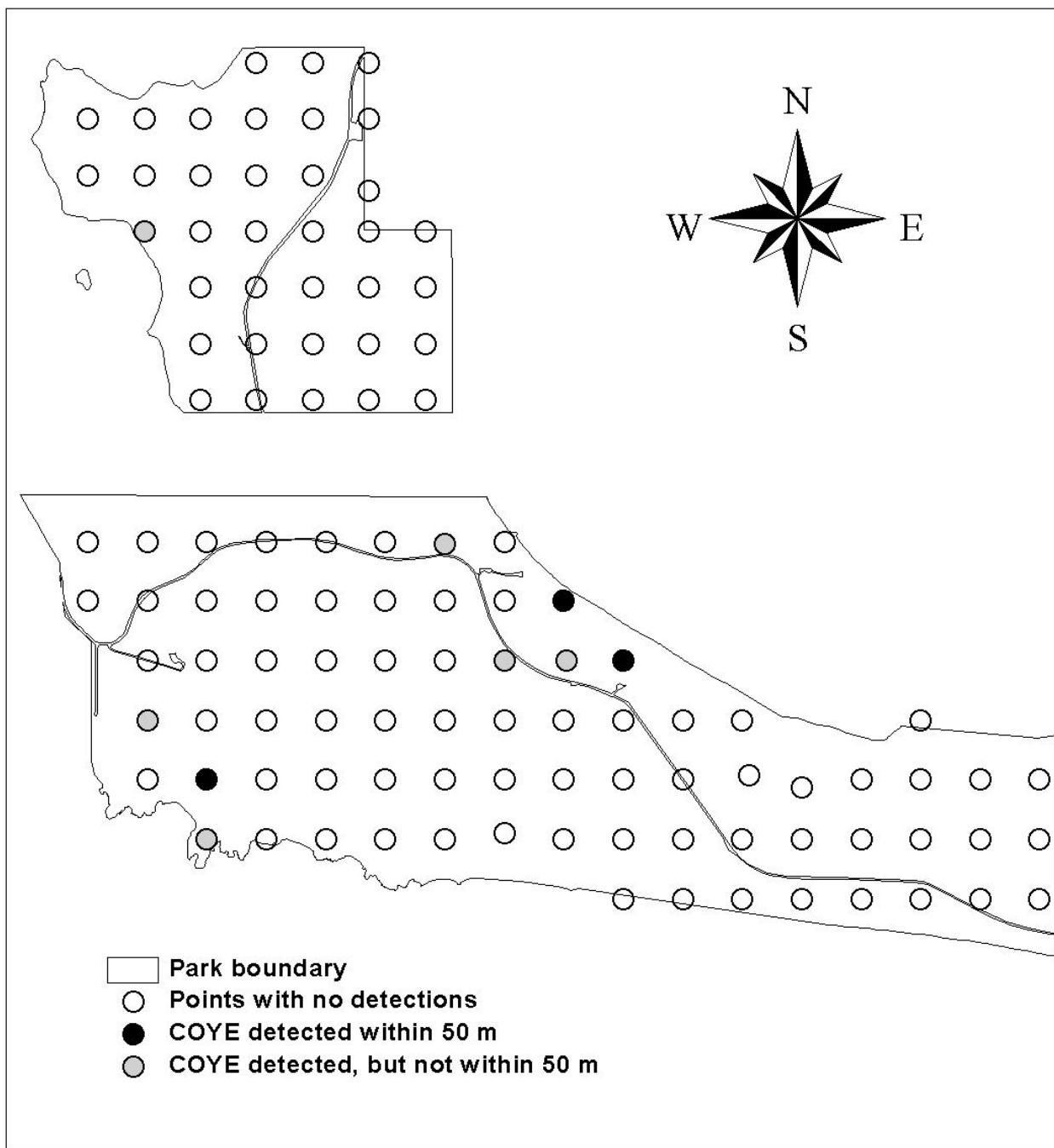
Figure 53. Common Yellowthroat point count detections.

Wilson's Warbler
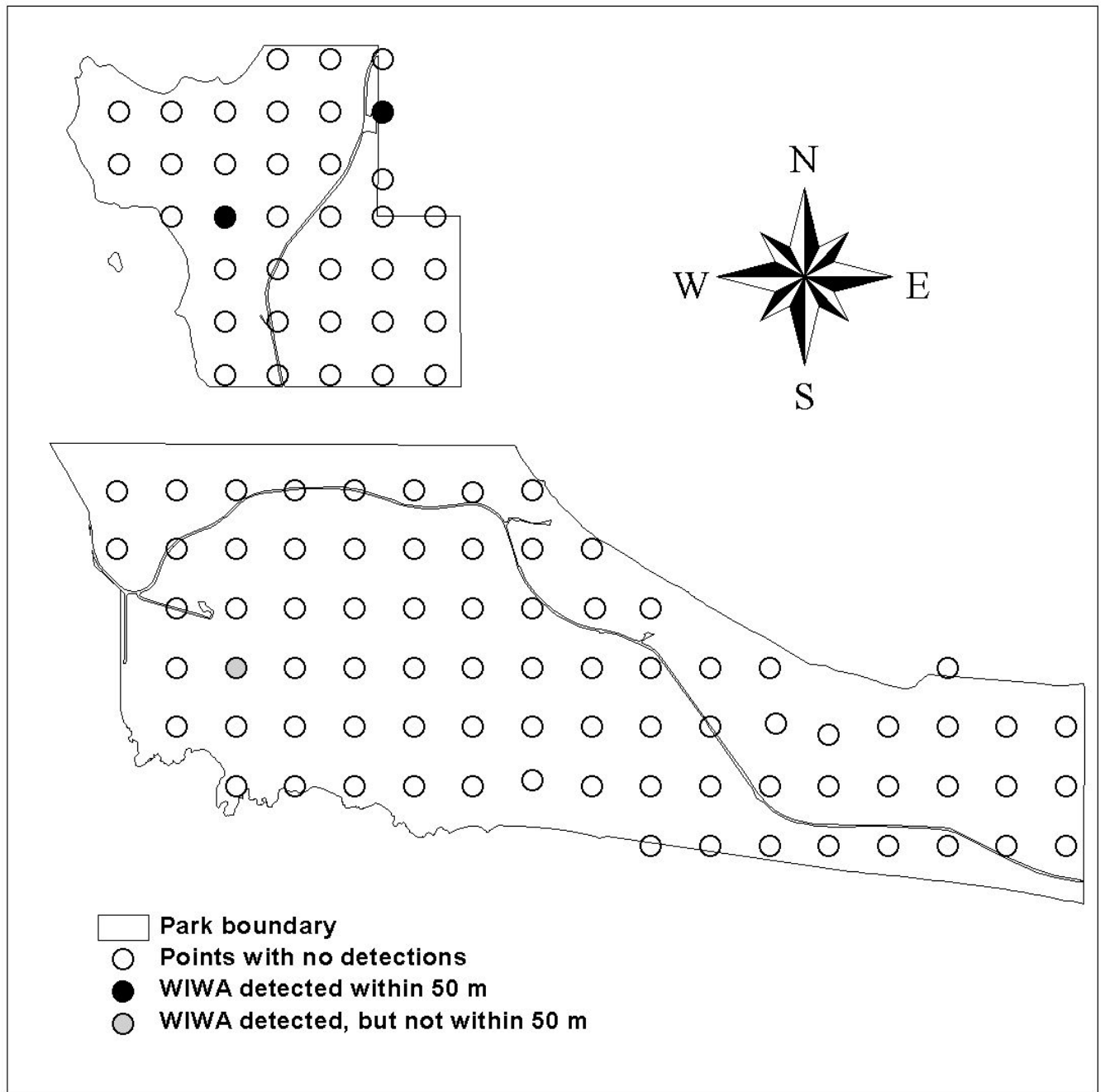
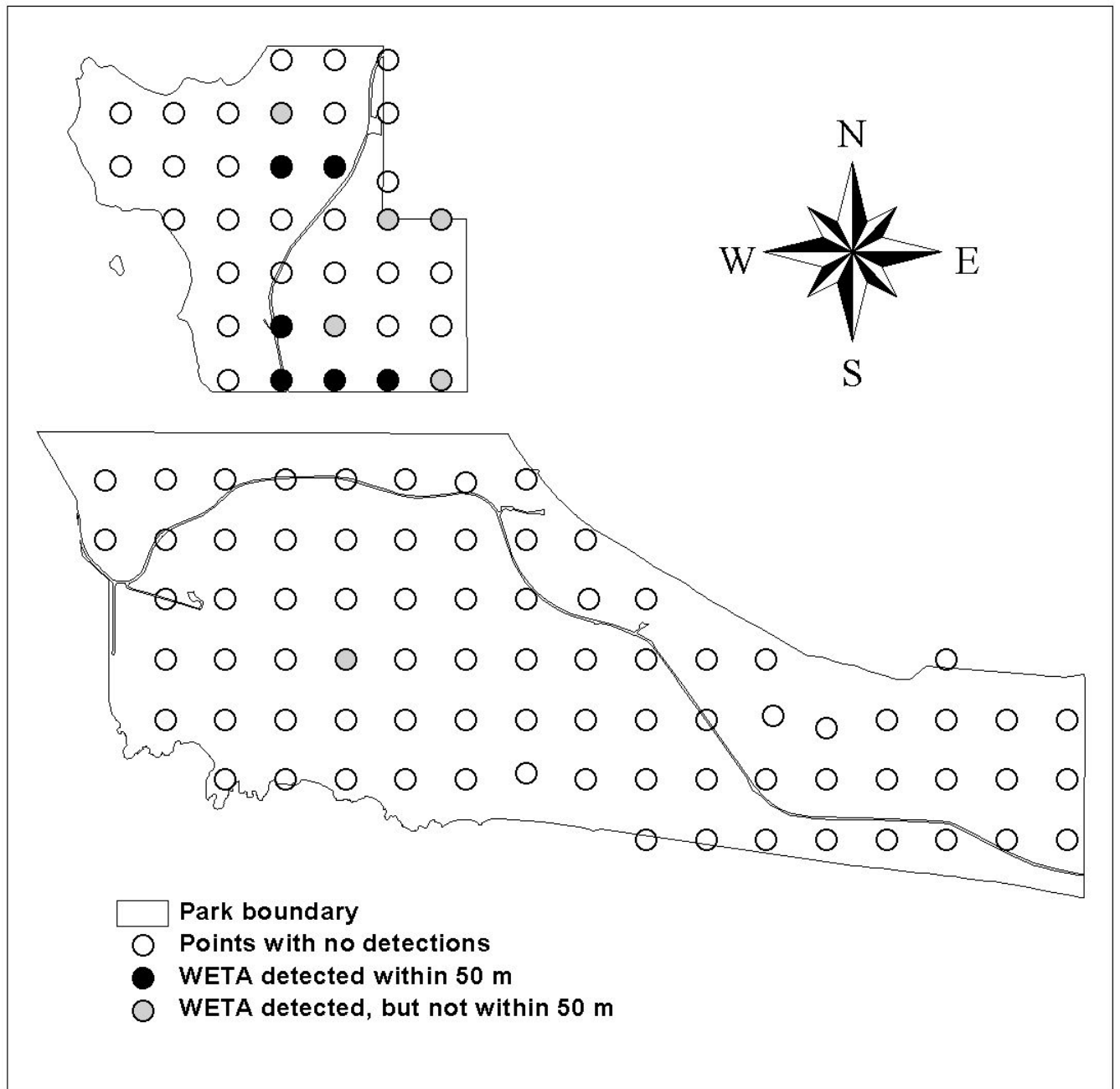Figure 54. Wilson's Warbler point count detections.

Western Tanager

Park boundary
○ Points with no detections
● WETA detected within 50 m
◐ WETA detected, but not within 50 m

Figure 55. Western Tanager point count detections.

Spotted Towhee
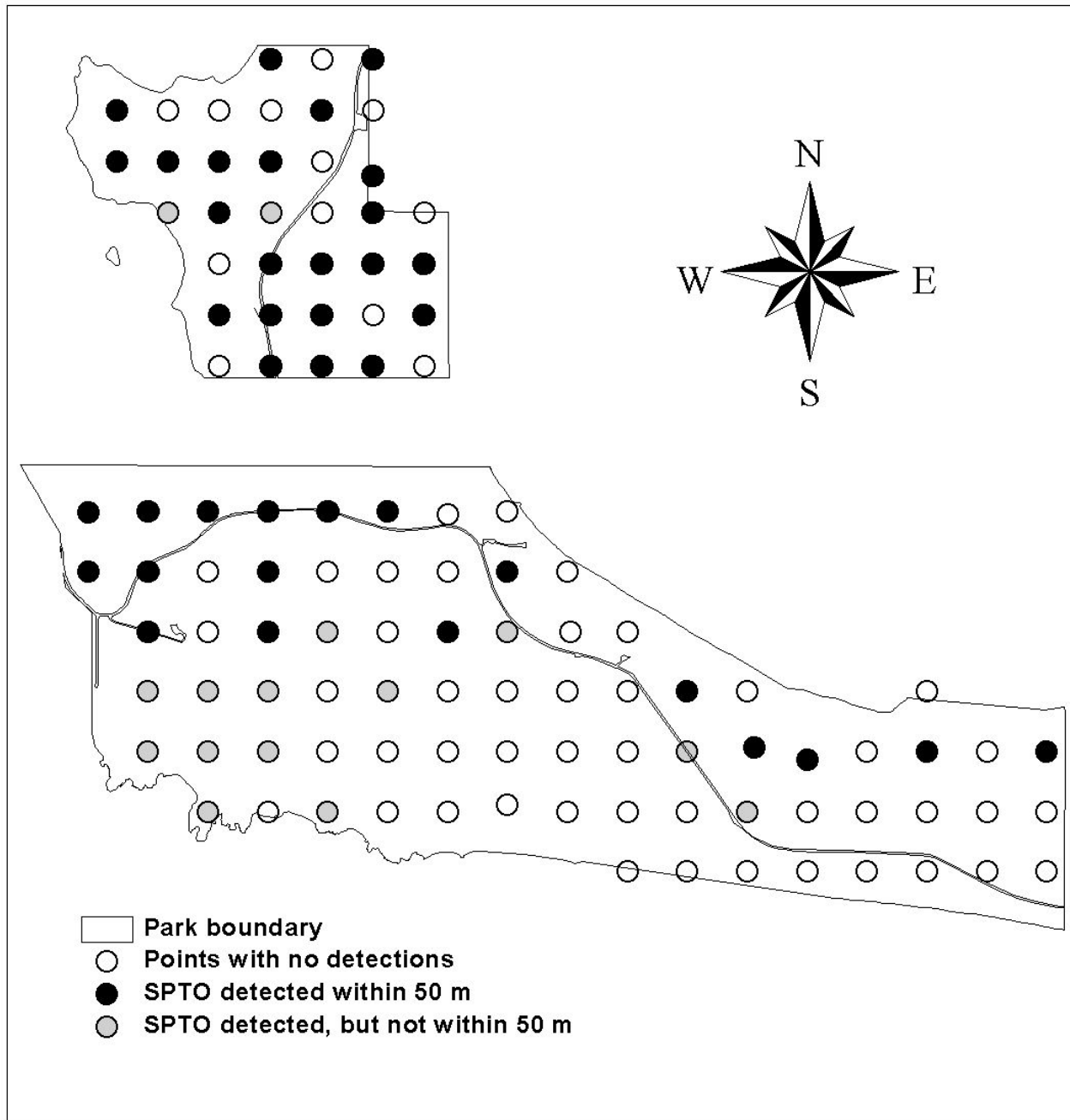
Figure 56. Spotted Towhee point count detections.
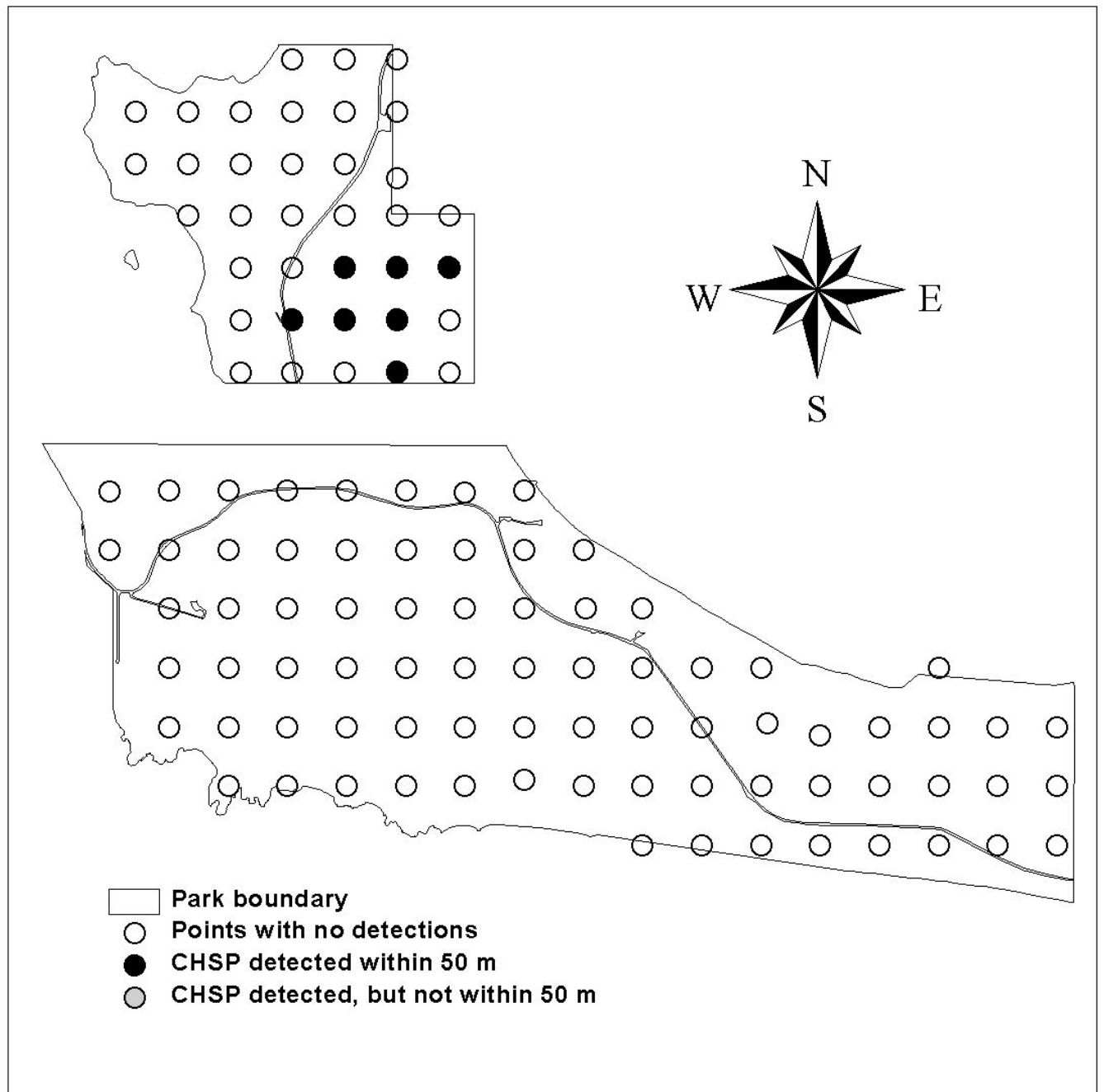
Chipping Sparrow

Figure 57. Chipping Sparrow point count detections.
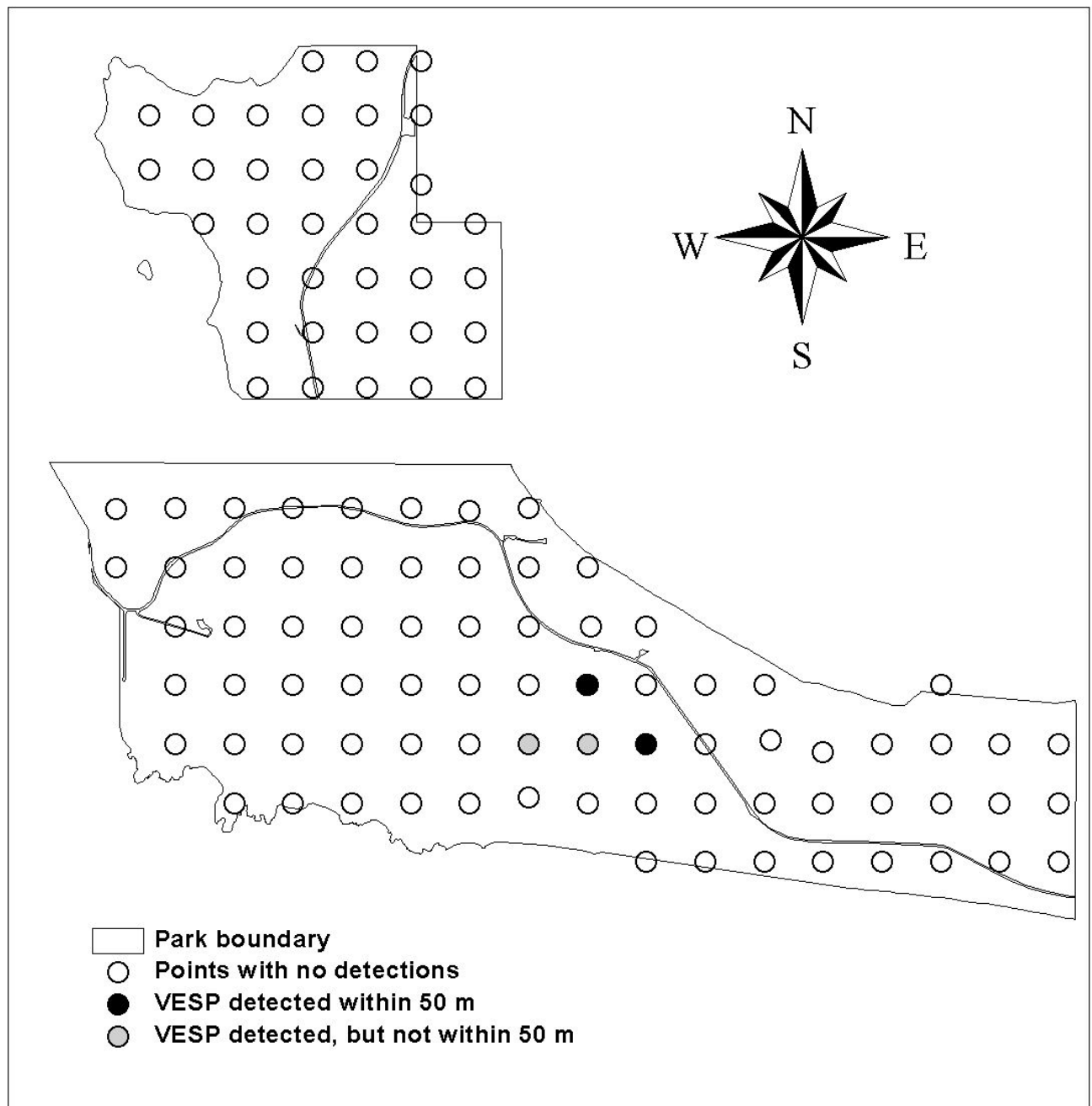
Vesper Sparrow

Figure 58. Vesper Sparrow point count detections.
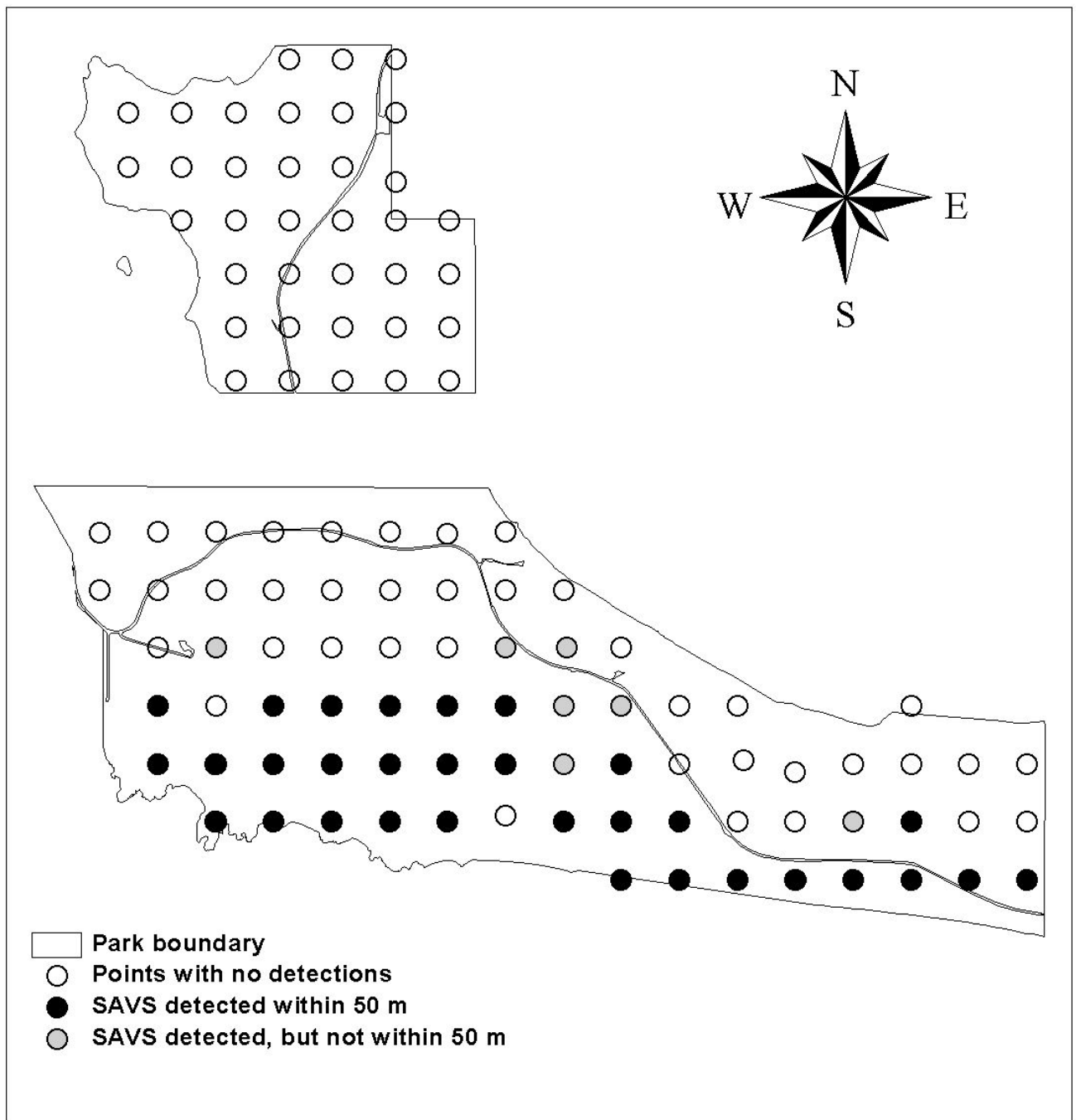
Savannah Sparrow

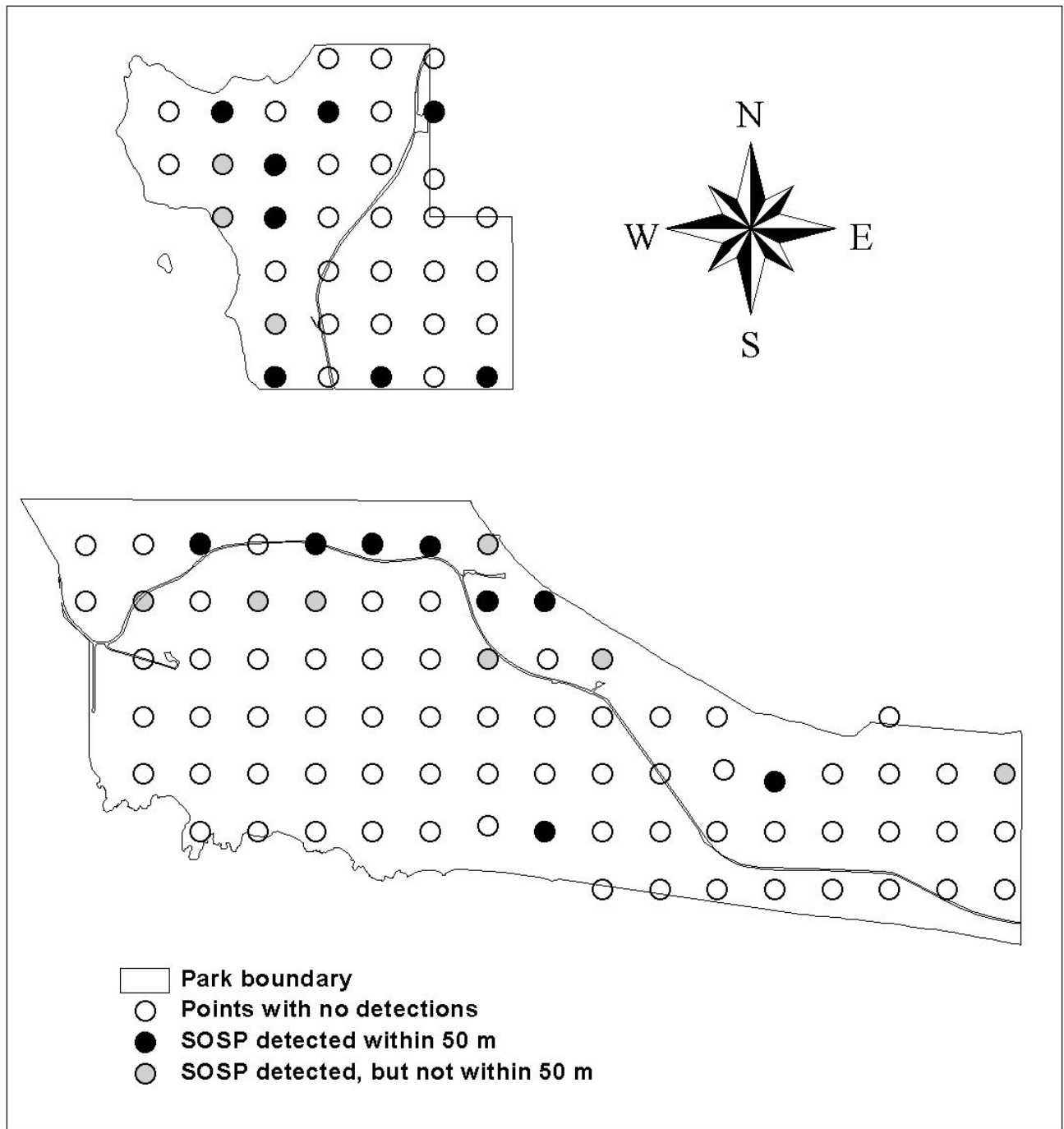Figure 59. Savannah Sparrow point count detections.

Song Sparrow

Figure 60. Song Sparrow point count detections.
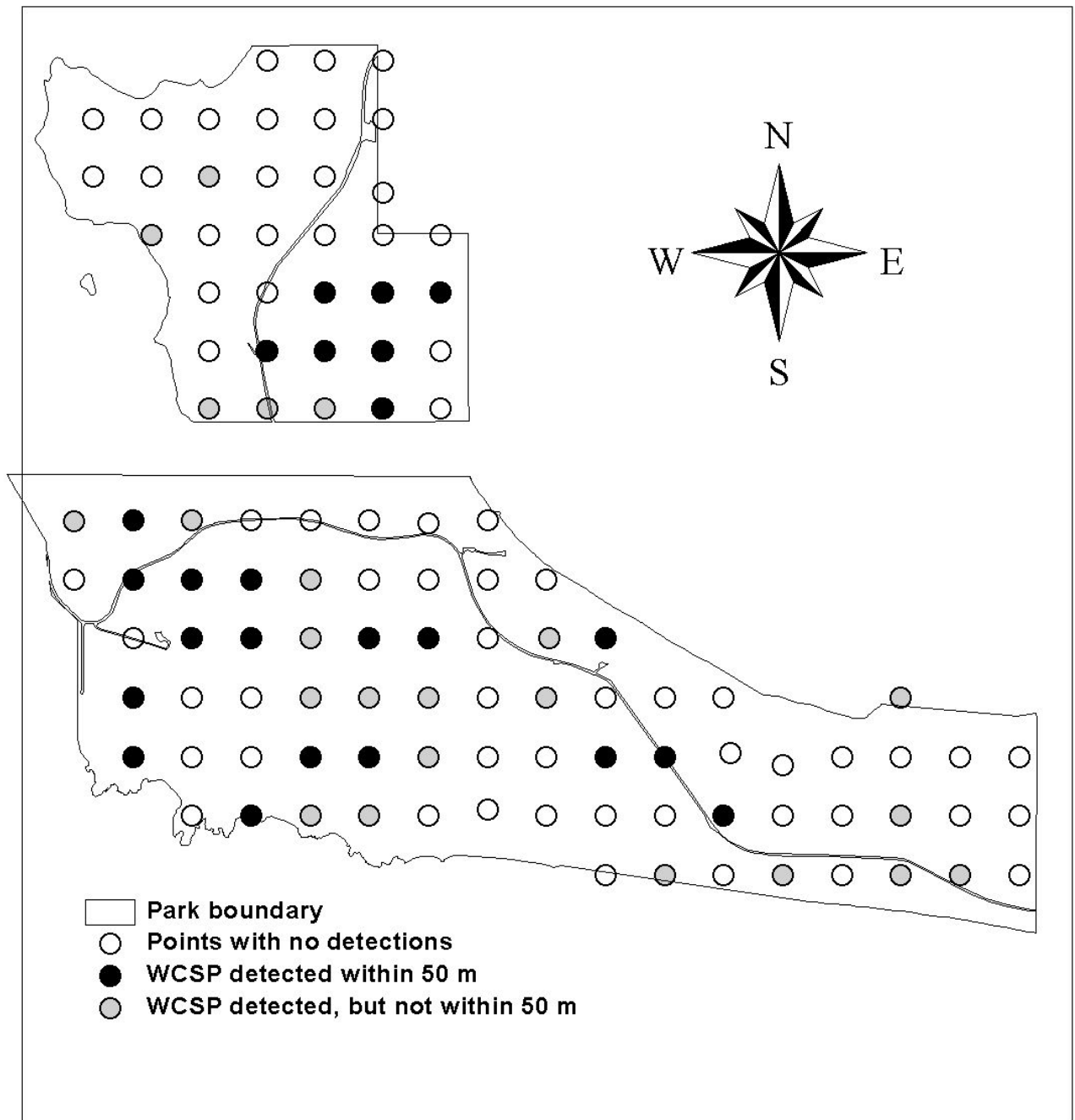
White-crowned Sparrow

Figure 61. White-crowned Sparrow point count detections.

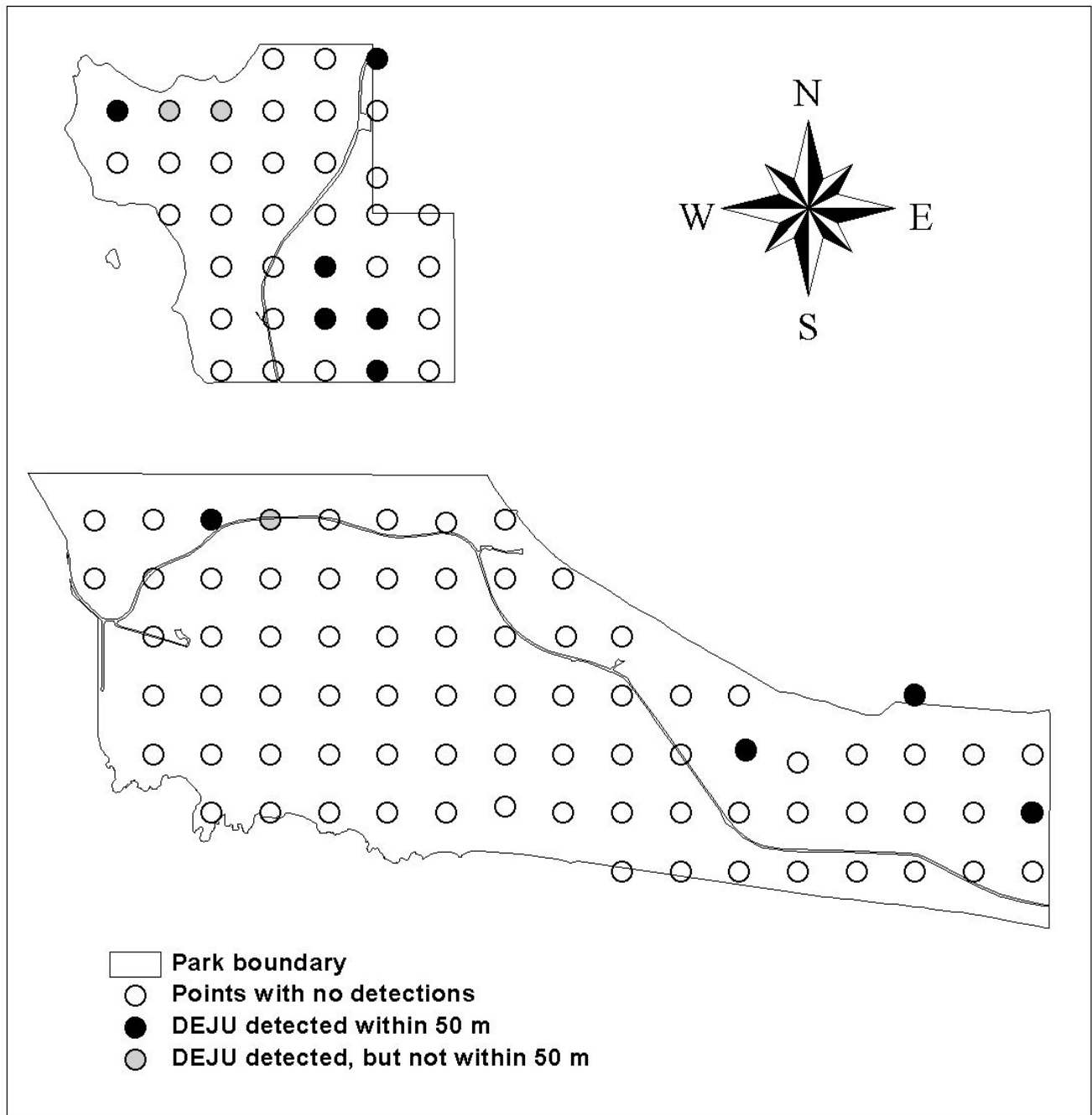# Dark-eyed Junco

Figure 62. Dark-eyed Junco point count detections.

Black-headed Grosbeak
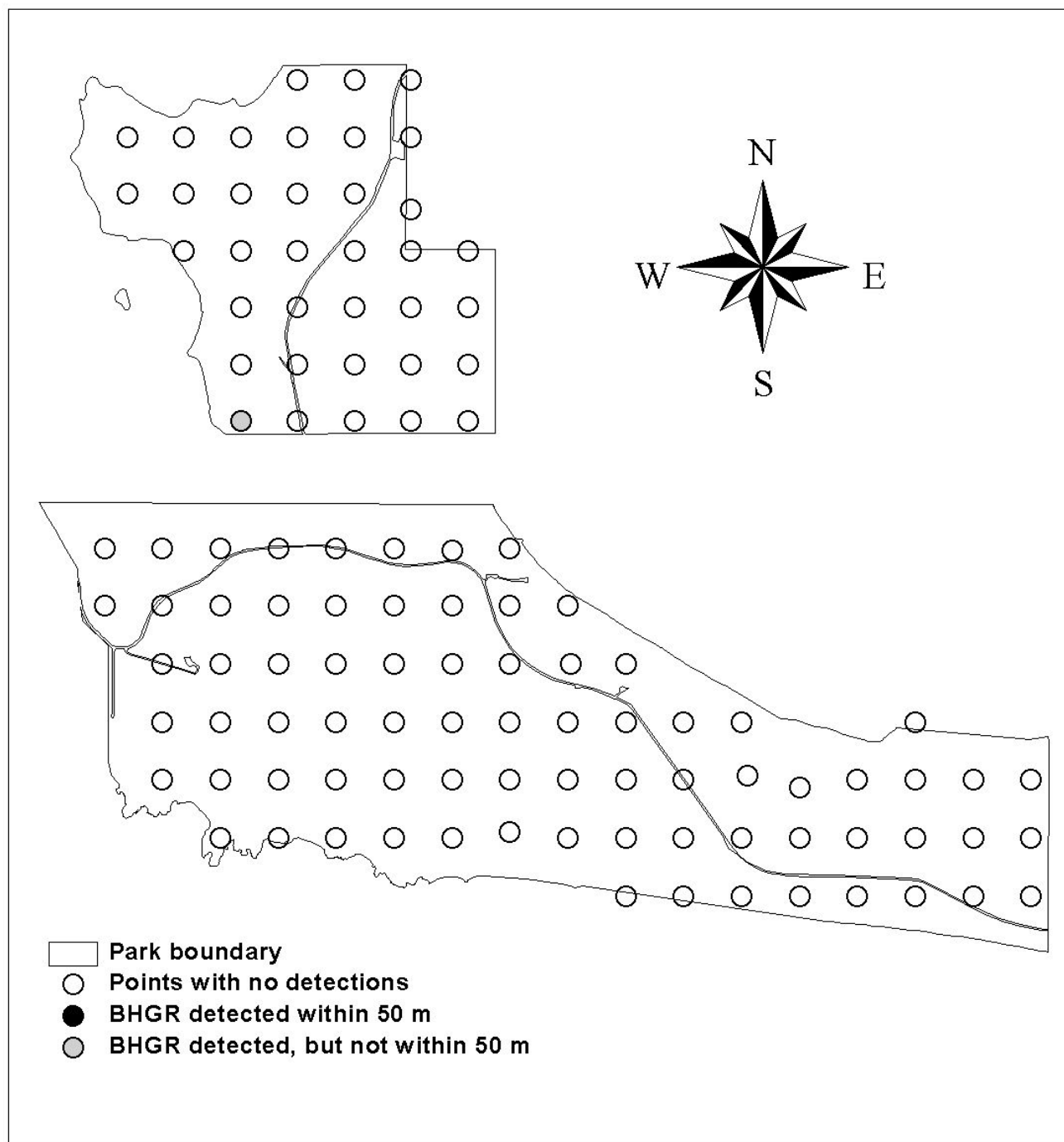
Figure 63. Black-headed Grosbeak point count detections.

Red-winged Blackbird
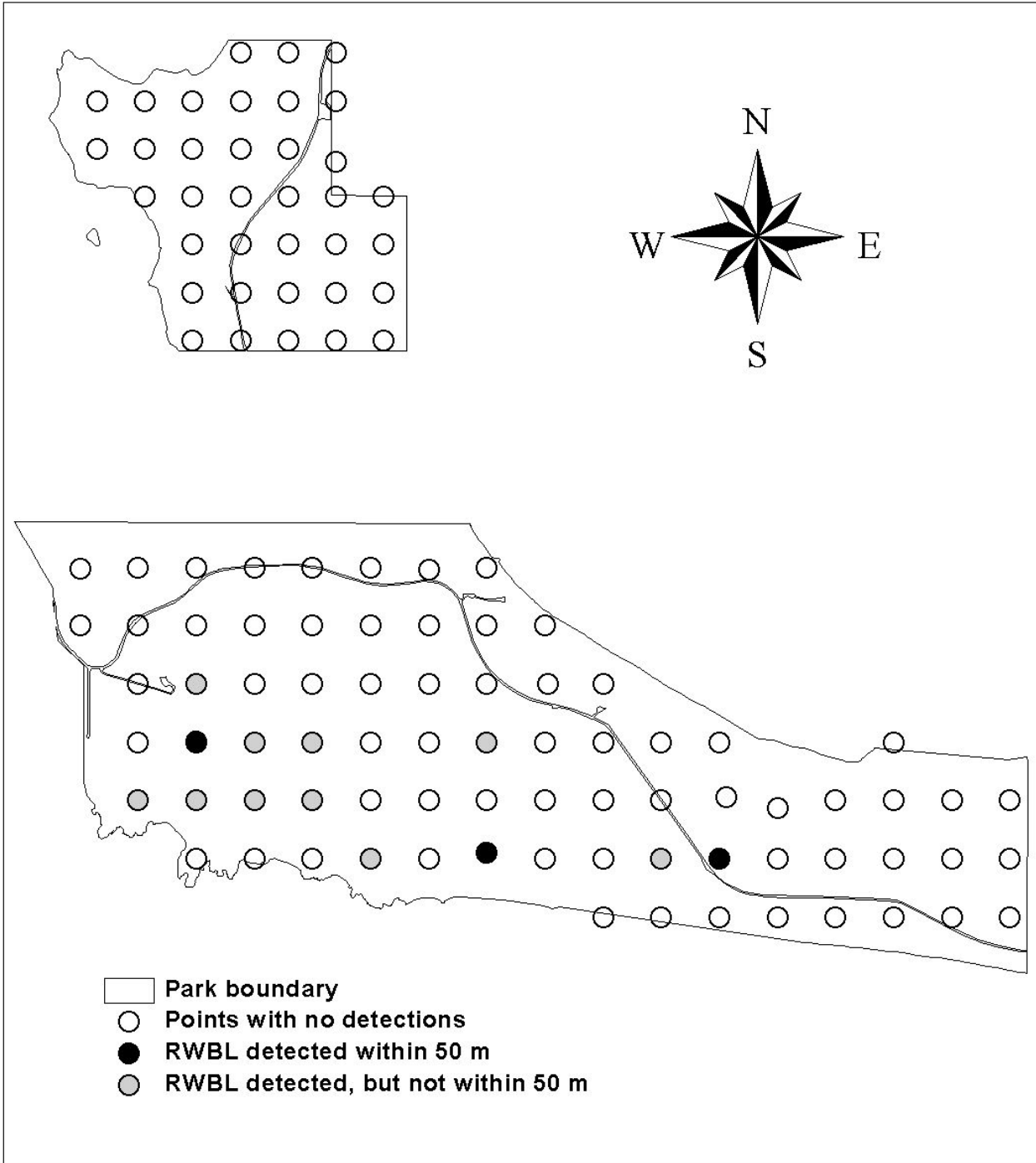
Figure 64. Red-winged Blackbird point count detections.

Brewer's Blackbird
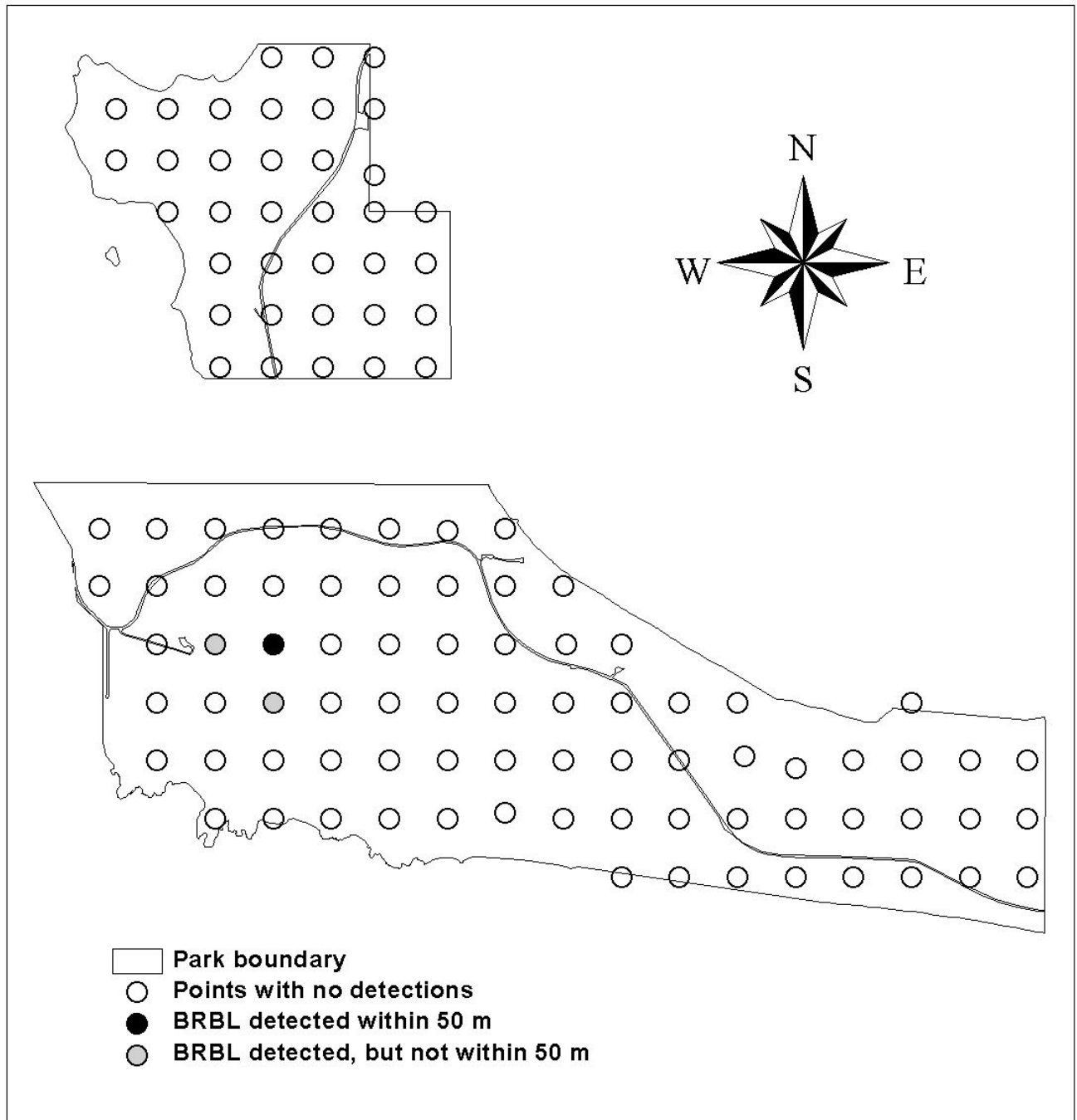
Figure 65. Brewer's Blackbird point count detections.

Brown-headed Cowbird

Figure 66. Brown-headed Cowbird point count detections.

Purple Finch

Figure 67. Purple Finch point count detections.

House Finch

Figure 68. House Finch point count detections.

Red Crossbill

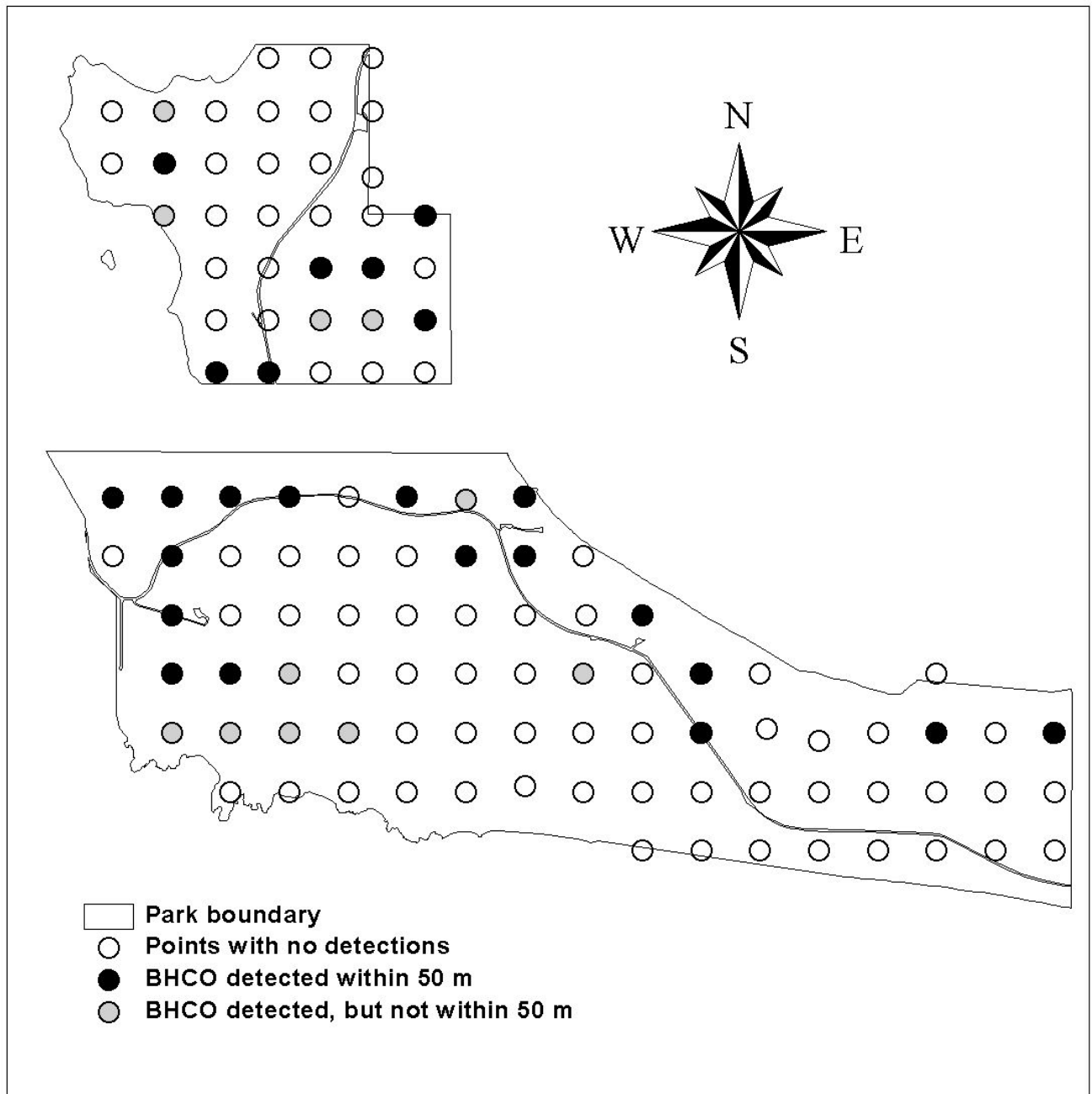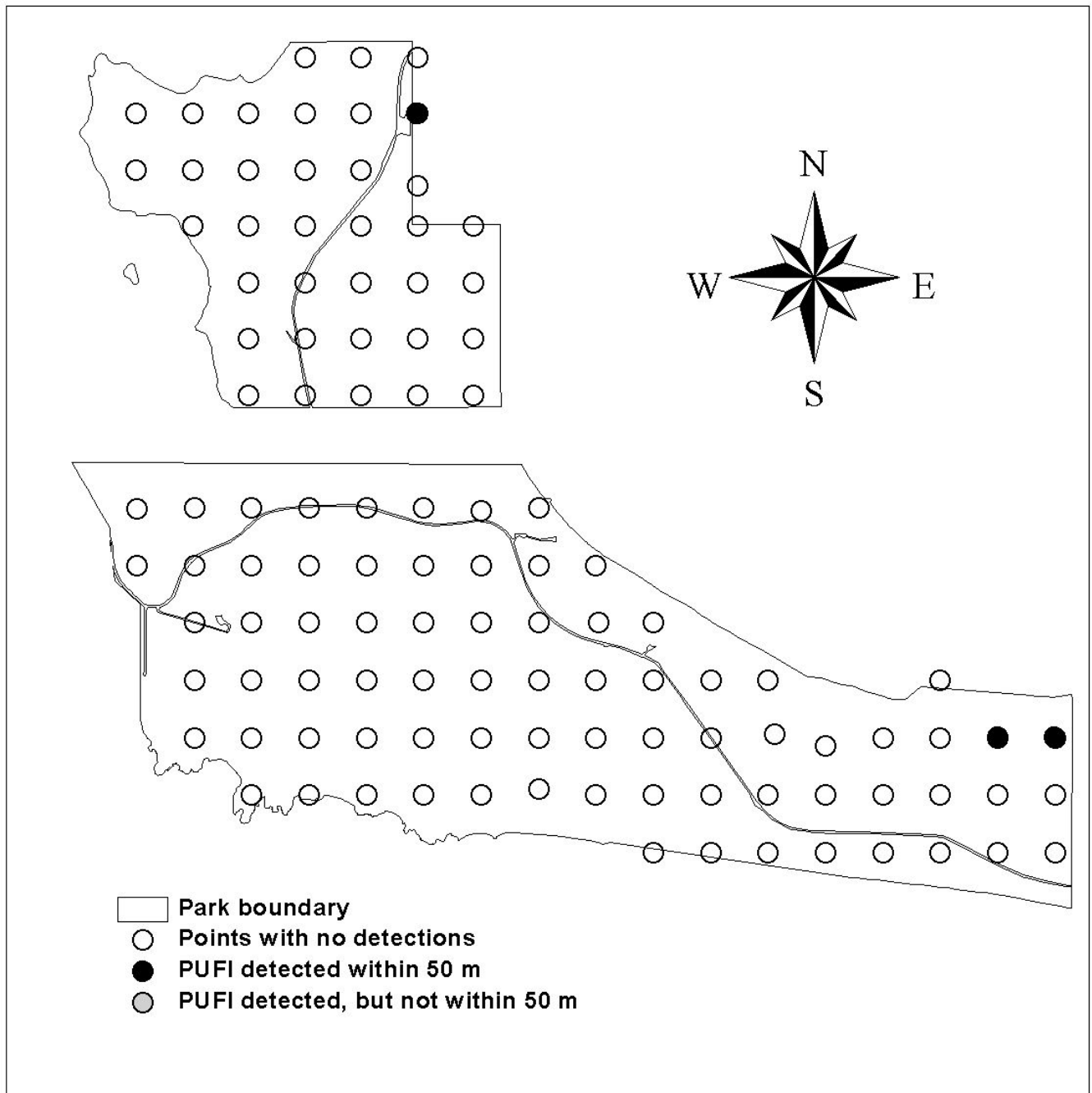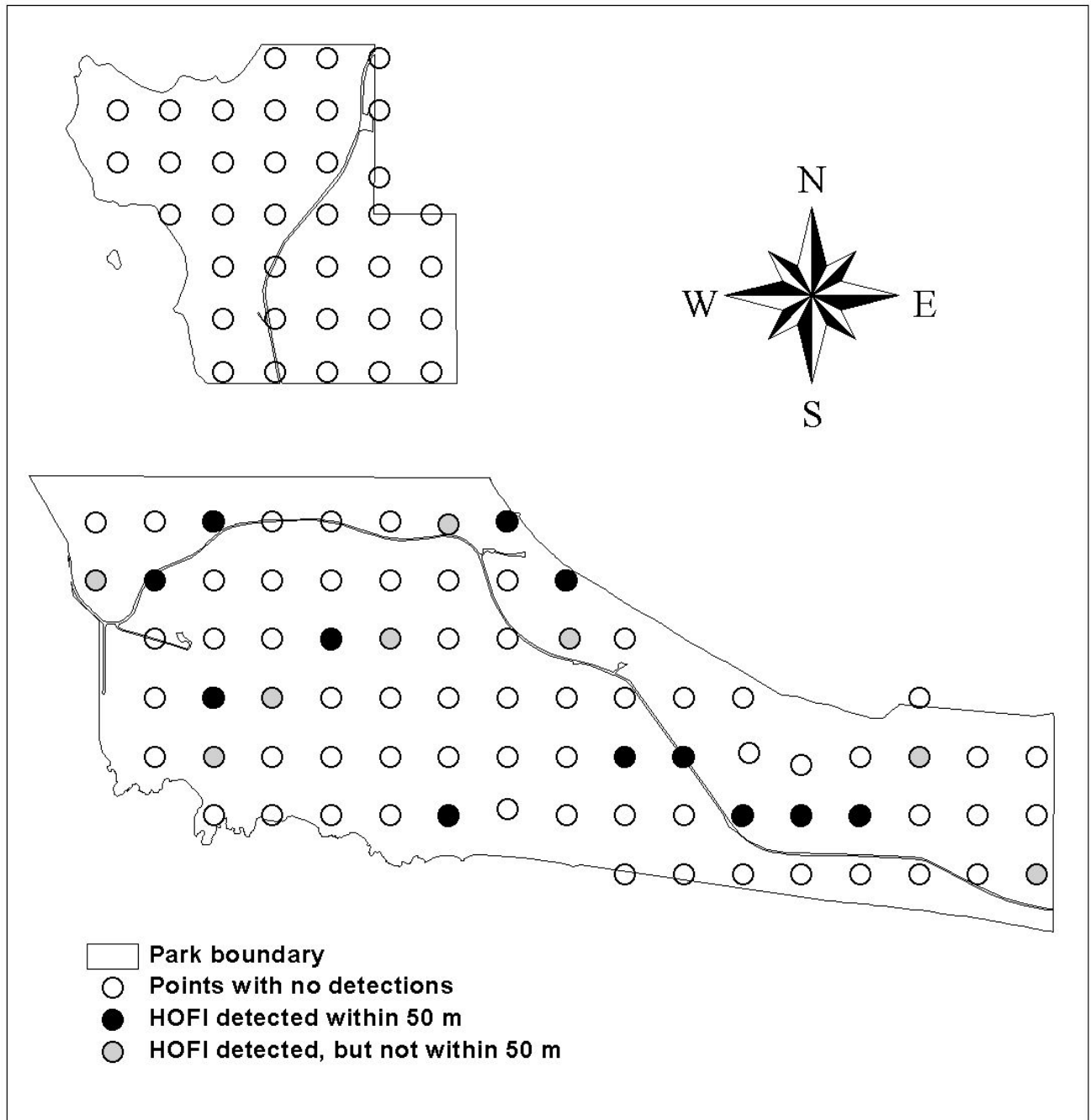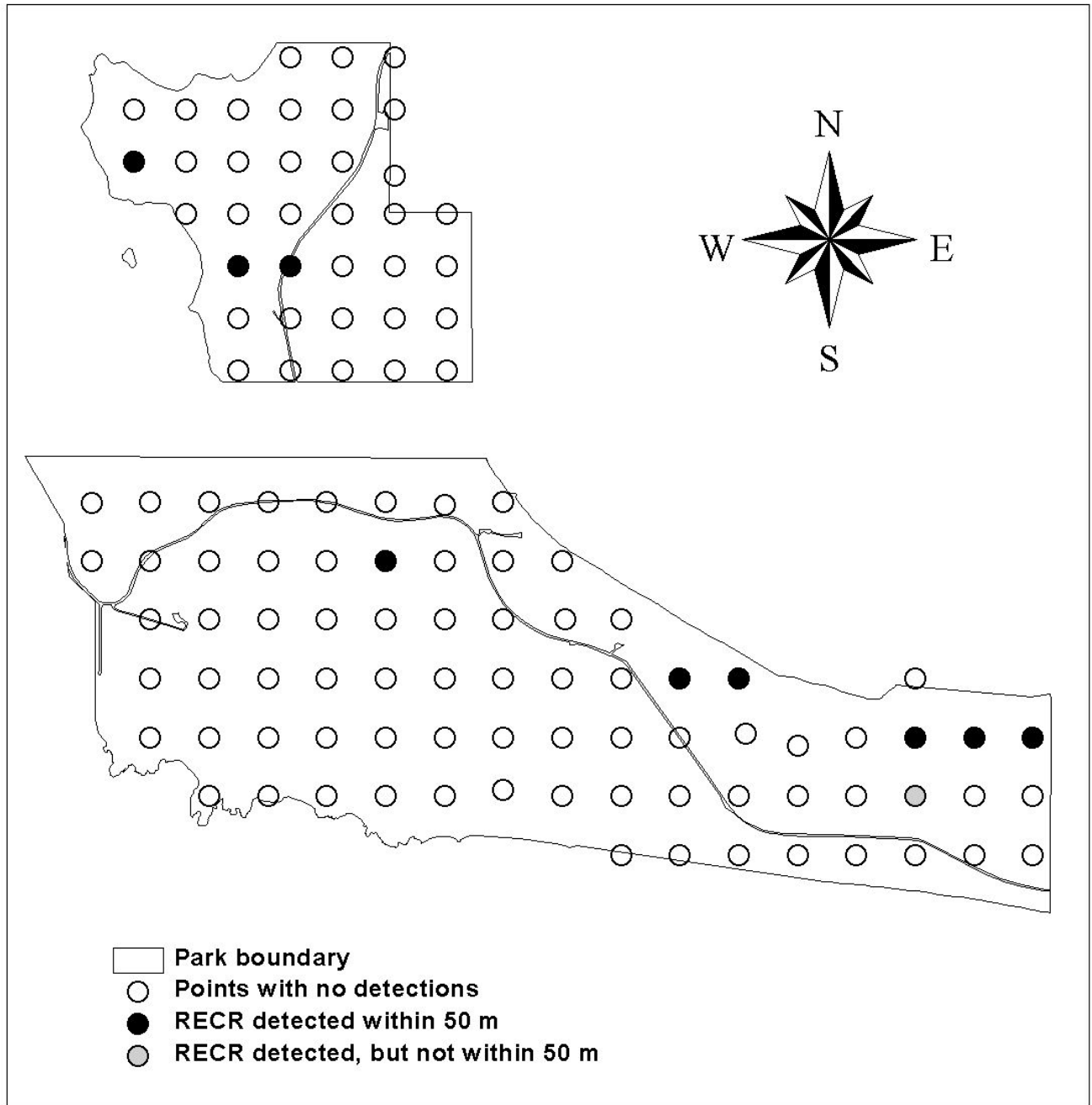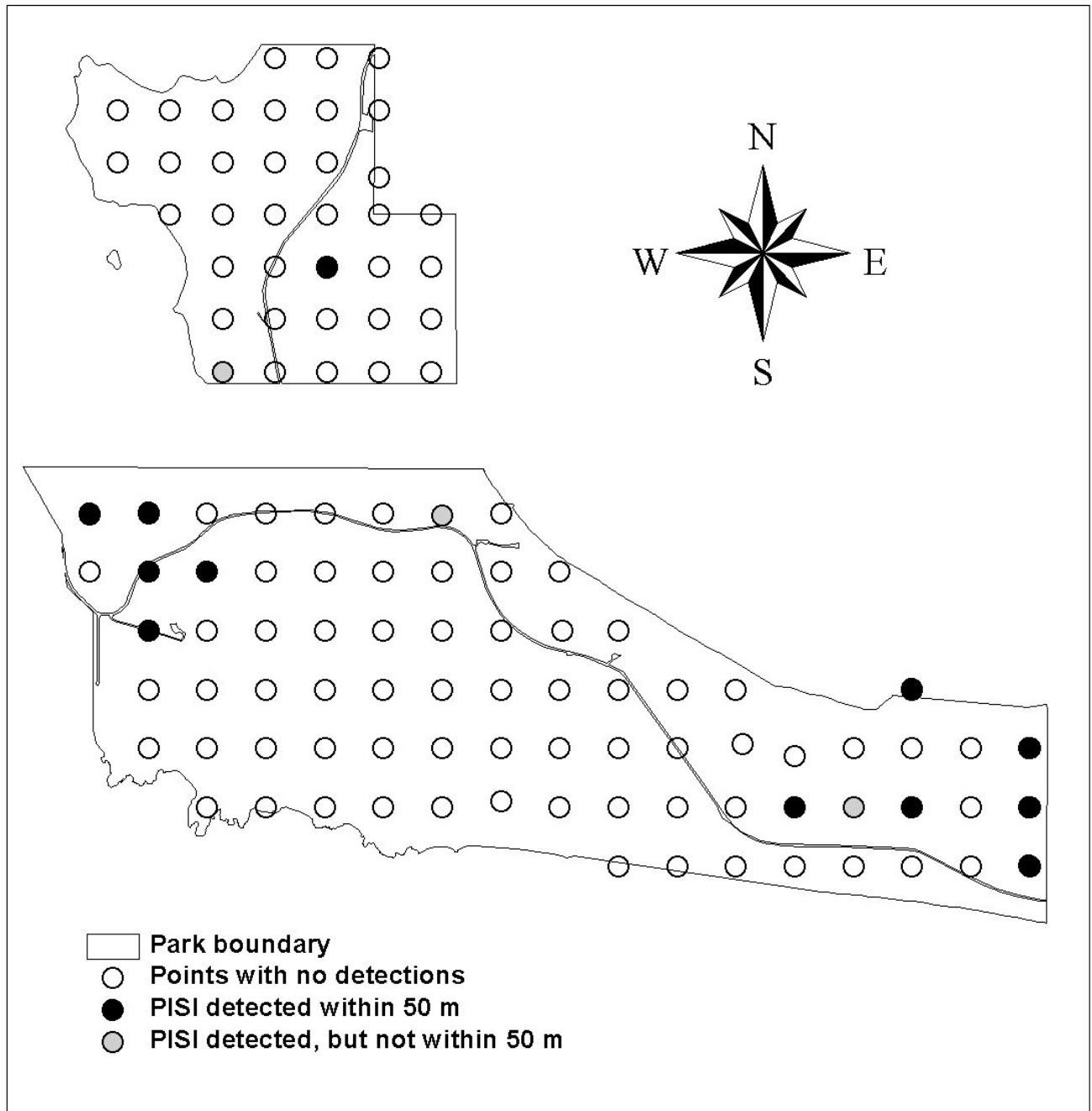Figure 69. Red Crossbill point count detections.

Pine Siskin

Figure 70. Pine Siskin point count detections.

American Goldfinch

Figure 71. American Goldfinch point count detections.

APPENDIX 1

**Meta-data for the
Avian Inventory of San Juan Island National Historical Park**

The accompanying CD contains four DBASE files: pct.dbf, densall.dbf, vega.dbf, and vegb.dbf. This document serves as meta-data for these files.

1. Point count data: PCT.dbf

Field: POINT
Description: A 4-character unique name for each survey point. The first character is 'A' (indicating American Camp) or 'B' (indicating English Camp). The last three characters are a 3-digit number (1 to 77 at American Camp, 1 to 36 at English Camp). **This field may be used to link data in each of the databases on this disk.**

Field: Noise
Description: Noise interference, scored from 1 to 5, where 1 = no noise, and 5 = severe noise interference. Only entered for the first record at each point.

Field: Time
Description: 4-character field indicating the time of day the point count began. Only entered for the first record at each point.

Field: SPEC
Description: 4-character bird species code.

Field: OBS1
Description: Horizontal distance to a bird when it was first observed. The '1' indicates it was the first bird of the indicated species detected at that point.

Field: OBS1PREV
Description: 'X' indicates the bird indicated in OBS1 was previously recorded at another survey point.

Field: OBS2
Description: Horizontal distance to a bird when it was first observed. The '2' indicates it was the second bird of the indicated species detected at that point.

Field: OBS2PREV
Description: 'X' indicates the bird indicated in OBS2 was previously recorded at another survey point.

Field: OBS3

Description: Horizontal distance to a bird when it was first observed. The '3' indicates it was the third bird of the indicated species detected at that point.

Field: OBS3PREV
Description: 'X' indicates the bird indicated in OBS3 was previously recorded at another survey point.

Field: OBS4
Description: Horizontal distance to a bird when it was first observed. The '4' indicates it was the fourth bird of the indicated species detected at that point.

Field: OBS4PREV
Description: 'X' indicates the bird indicated in OBS4 was previously recorded at another survey point.

Field: OBS5
Description: Horizontal distance to a bird when it was first observed. The '5' indicates it was the fifth bird of the indicated species detected at that point.

Field: OBS5PREV
Description: 'X' indicates the bird indicated in OBS5 was previously recorded at another survey point.

Field: OBS6
Description: Horizontal distance to a bird when it was first observed. The '6' indicates it was the sixth bird of the indicated species detected at that point.

Field: OBS6PREV
Description: 'X' indicates the bird indicated in OBS6 was previously recorded at another survey point.

Field: OBS7
Description: Horizontal distance to a bird when it was first observed. The '7' indicates it was the seventh bird of the indicated species detected at that point.

Field: OBS7PREV
Description: 'X' indicates the bird indicated in OBS7 was previously recorded at another survey point.

Field: OBS8
Description: Horizontal distance to a bird when it was first observed. The '8' indicates it was the eighth bird of the indicated species detected at that point.

Field: OBS8PREV
Description: 'X' indicates the bird indicated in OBS8 was previously recorded at another survey point.

2. Canopy cover data: DENSALL.dbf

Field: Point
Description: 4-character unique name for each survey point.

Field: North
Description: Number of open vertices (out of 96 possible) on the spherical densiometer face, when the observer was facing north.

Field: East
Description: Number of open vertices (out of 96 possible) on the spherical densiometer face, when the observer was facing east.

Field: South
Description: Number of open vertices (out of 96 possible) on the spherical densiometer face, when the observer was facing south.

Field: West
Description: Number of open vertices (out of 96 possible) on the spherical densiometer face, when the observer was facing west.

3. Habitat Data I: VEGA.dbf

Field: POINT
Description: 4-character unique name for each survey point.

Field: HAB
Description: 4-character code identifying the dominant habitat type within a 50 m radius of the survey point. Codes are as follows:

Code	Habitat
DOFI	Douglas-fir
CONM	Mixed Conifer
CODM	Conifer Deciduous Mix
REAL	Red Alder
SHRU	Shrub
GRAS	Grassland
SADU	Sand Dune
BEAC	Beach
DEVO	Developed Area

Field: HAB2
Description: 4-character code identifying a secondary habitat type (if present) within a 50 m radius of the survey point. Codes are the same as in HAB.

Field: BIGHAB
Description: Used for grouping data in DISTANCE analysis. 'FORE' indicates forested habitats, 'OPEN' indicates open habitats.

Field: DATE
Description: The date of the survey (mm/dd/yy).

Field: ELEV
Description: Elevation in meters, as determined from topographic maps.

Field: BIRDOBS
Description: Initials of the point count observer.

Field: VEGOBS
Description: Initials of the habitat observer.

Field: NORTHING
Description: UTM northing (NAD83) of the survey point.

Field: EASTING
Description: UTM easting (NAD83) of the survey point.

Field: GPSERROR
Description: Error in meters of GPS reading, as provided by hand-held GPS unit.

Field: ASPECT
Description: Compass degrees indicating the dominant aspect of the 50 m radius point count circle.

Field: SLOPE
Description: Average slope (degrees) of the 50 m circle, measured with a clinometer.

Field: ROCKPRES
Description: Y=exposed rock is a substantial feature of the habitat, N=little or no exposed rock.

Field: MOIST
Description: Soil moisture in the 50 m circle. 1=dry, 2=moist, 3=wet.

Field: STANDH20
Description: Area (square meters) of the 50 m circle covered in standing water.

Field: RUNH20
Description: Index describing running water in the 50 m circle. 1=none, 2=trickle, 3=small stream, 4=large stream, 5=river.

The following fields, all of which begin with 'A' describe conditions in the first of two 20m x 40m subplots adjacent to the point count station.

Field: APLOTHAB
Description: 4-character code identifying the dominant habitat type within the subplot. Allowable codes are the same as for the field 'HAB' (see above).

Field: AHERBCAN
Description: Average height (cm) of the herbaceous canopy.

Field: ATREECAN
Description: Average height (m) of the tree canopy.

Field: ATREESCAN
Description: Average height (m) of the tree subcanopy, if present.

Field: Ashrubcan
Description: Average height (m) of the shrub canopy.

Field: Ashrubscan
Description: Average height (m) of the shrub subcanopy, if present.

Field: Atree1id
Description: 6-letter code (first 3 letters of genus followed by first 3 letters of species) of a plant species covering at least 1% of the subplot, at least 5m above ground.

Field: Atree123
Description: Count of stems 1-23cm dbh of the species indicated in Atree1id.

Field: Atree153
Description: Count of stems 24-53cm dbh of the species indicated in Atree1id.

Field: Atree181
Description: Count of stems 54-81cm dbh of the species indicated in Atree1id.

Field: Atree1122
Description: Count of stems 82-122cm dbh of the species indicated in Atree1id.

Field: Atree1123
Description: Count of stems >122 cm dbh of the species listed in Atree1id.

Field: Atree1hcov
Description: Percent cover of the species indicated in Atree1id, considering only vegetation greater than 20m above ground.

Field: Atree1mcov
Description: Percent cover of the species indicated in Atree1id, considering only
vegetation between 5 and 20 m above ground.

Field: Atree2id
Description: 6-letter code (first 3 letters of genus followed by first 3 letters of species) of
another plant species covering at least 1% of the subplot, at least 5m above ground.

Fields: Atree2…
Description: Field follow the same conventions as above, but applied the species
indicated in Atree2id, rather than Atree1id.

**Fields following the same conventions are provided for six additional plant species
(Atree3id…Atree6id).**

Field: Asnag23
Description: Number of snags (dead tree, any species, >1.5 m tall) 1-23 cm dbh.

Field: Asnag53
Description: Number of snags 24-53 cm dbh.

Field: Asnag81
Description: Number of snags 54-81 cm dbh.

Field: Asnag122
Description: Number of snags 82-122 cm dbh.

Field: Asnag123
Description: Number of snags >122 cm dbh.

Field: Adecay1
Description: Number of logs (>20 cm dbh) crossing the center of the plot, perpendicular
to its long axis (such that the observer had to step or climb over them) of decay class 1.
Decay classes were determined as follows:

Characteristic	Decay Class 1	Decay Class 2	Decay Class 3
Bark	Mostly intact	Mostly sloughed/sloughing	Absent
3 cm twigs	Present to absent	Absent	Absent
Exposed wood texture	Intact, hard	Large pieces, partly soft	Small pieces, soft
Portion of log on ground	Log supporting itself	Log sagging on ground	Log entirely grounded
Exposed wood color	Original	Original to reddish	Reddish to brown
Epiphytes	None	Conifer seedlings	Moss and conif. sdlng
Invading roots	None	Shallow seedlings	Roots penetrating
Log x-sectional shape	Round	Round	Oval or collapsed

Field: Adecay2
Description: Number of logs (>20 cm dbh) crossing the center of the plot, perpendicular to its long axis (such that the observer had to step or climb over them) of decay class 2.

Field: Adecay3
Description: Number of logs (>20 cm dbh) crossing the center of the plot, perpendicular to its long axis (such that the observer had to step or climb over them) of decay class 3.

Field: Atotcovh
Description: Percent cover of all contributing species, considering only vegetation greater than 20m above ground.

Field: Atotcovm
Description: Percent cover of all contributing species, considering only vegetation between 5 and 20 m above ground.

Field: Awvtotcov
Description: Percent cover of all contributing species (tree or shrub), considering only vegetation between 1 and 5 m above ground.

Field: Ashrubonly
Description: Percent cover of all shrub species, considering only vegetation between 1 and 5 m above ground.

Field: Awv1id
Description: 6-letter code (first 3 letters of genus followed by first 3 letters of species) of a plant species covering at least 1% of the subplot, considering only vegetation between 1 and 5 m above ground.

Field: Awv1cov
Description: Considering only vegetation between 1 and 5 m above ground, percent cover of species indicated in Awv1id.

Field: Awv1ht
Description: Avg. ht (m) of species indicated in Awv1id.

Fields following the same conventions are provided for 5 more plant species.

The following field all refer to ground cover below 0.1 m above ground.

Field: Asnow
Description: Percent of ground covered by snow.

Field: Awater
Description: Percent of ground covered by standing or running water.

Field: Arock
Description: Percent of ground comprised of exposed rock.

Field: Abare
Description: Percent of ground comprised of bare soil.

Field: Alitter
Description: Percent of ground covered by organic litter.

Field: Adw
Description: Percent of ground covered by downed wood.

Field: Agrass
Description: Percent of ground covered by grass.

Field: Asedge
Description: Percent of ground covered by sedge.

Field: Aforb
Description: Percent of ground covered by forbs.

Field: Afern
Description: Percent of ground covered by ferns.

Field: Ashrub
Description: Percent of ground covered by shrubs.

Field: Atree
Description: Percent of ground covered by trees (trunks + foliage).

Field: Amoss
Description: Percent of ground covered by moss.

Field: Aother1id
Description: One-word description of any additional ground cover item.

Field: Aother1cov
Description: Percent of ground covered by item indicated in Aother1id.

4. Habitat Data II: VEGB.dbf

Vegb.dbf contains data pertaining to the second of the two vegetation subplots associated with each point count station. The first field, 'point' can serve as a link to each of the other databases. The remaining fields are identical to their counterparts in Vega.dbf, except they all begin with 'B'.